

The AMSAT[®] Journal

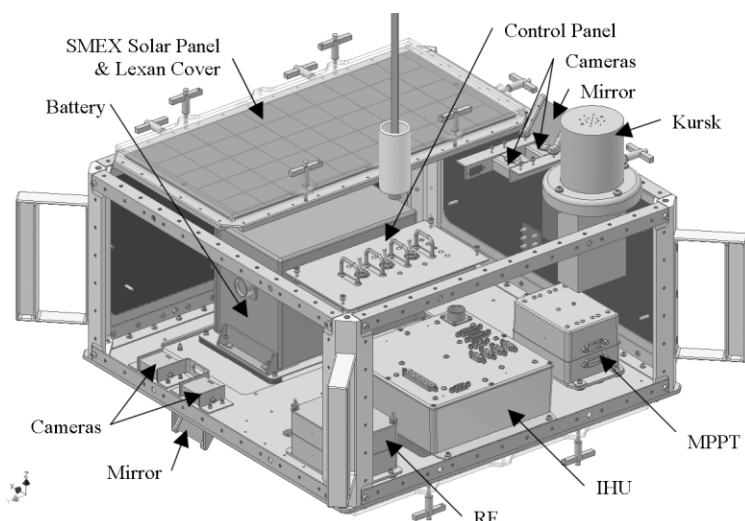


Editor-in-Chief:
Ed Long, WA4SWJ

Assistant Editors:
Bill Hook, W3QBC
JoAnne Maenpaa, K9JKM

Volume 33, Number 5

September/October 2010



ARISSat-1



Beginners - How to Begin? (Part II)

in this issue

AMSAT Announcements2

Apogee View3
by Barry Baines • WD4ASW

Getting Started on the.....4
Amateur Radio Satellites (Part II)
by Keith Baker • KB1SF/VA3KSF

An ARISSat-1 Overview9
by Anthony Monterio • AA2TX
and Gould Smith • WA4SXM

AO-7 / Simplex / Cross Band12
Satellite QSO
by Steven H. Thomas, Sr. • NL7VX

Salvaging California Amplifier ...13
Downconverters for Satellite Use
by John M. Franke • WA4WDL

AMSAT and ITAR: Lessons.....16
Learned
by Barry Baines • WD4ASW

AMSAT Telemetry24

BoD Minutes.....29
by Alan Biddle • WA4SCA

Symposium Photographs30
by Art Feller • W4ART

Periodicals
POSTAGE PAID
At Silver Spring, MD
and at additional
mailing offices

AMSAT-NA
850 Silgo Avenue, Suite 600
Silver Spring, MD 20910-4730

How You Can Help Build New and Exciting Satellites

Donate to the President's Club

Gold, Silver, Bronze and Core levels are available to match your ability to participate.

Cash Gifts

Visa, or MasterCard or checks are accepted. And, you can specify how your contribution is to be used.

Gift of Life Insurance

US taxpayers may be able to receive a significant income tax deduction by making The Radio Amateur Satellite Corporation the owner and beneficiary of life insurance policies.

Gift of Stocks or other Securities

US taxpayers should be able to avoid capital gains taxes on appreciated securities and receive a deduction for their fair market value.

Bequest

A codicil in your will, naming The Radio Amateur Satellite Corporation as a beneficiary will help insure the continuance of the Amateur Radio Satellite program.

Call the AMSAT-NA office at 301-589-6062 for questions on any or all of these ways you can help build new and exciting satellites.

Support AMSAT-NA

AMSAT Announcements

Second Amateur Radio Station to be Activated on ISS

The original VHF and UHF Ericsson handheld radios in the Russian segment of the ISS originally used for ARISS have been approved by NASA for use in the US segment of the space station. When the Ericsson radios are installed in the Columbus module it will become the second Amateur Radio station aboard the ISS. A new power cable for the Ericsson radios is being delivered to the ISS.

ARISS members Kenneth Ransom and Steve Ponder met with Astronaut Paolo Nespoli for a training session on how to install the hardware in the Columbus module during Expedition 26. This launch is currently scheduled for December 13.

Paolo is looking forward to doing the installation work and is excited about using the equipment.

The second station is planned to initially use the same frequencies currently used by the Kenwood D-700 Amateur Radio transceiver aboard the ISS. Studies are underway to determine a compatible operating plan which would allow both stations to operate simultaneously.

[ANS thanks the ARISS team for the above information] 🌐

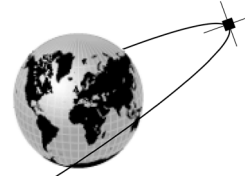
AMSAT's Mission

AMSAT is a non-profit volunteer organization which designs, builds and operates experimental satellites and promotes space education. We work in partnership with government, industry, educational institutions and fellow Amateur Radio societies. We encourage technical and scientific innovation, and promote the training and development of skilled satellite and ground system designers and operators.

AMSAT's Vision

Our Vision is to deploy satellite systems with the goal of providing wide-area and continuous coverage. AMSAT will continue active participation in human space missions and support a stream of LEO satellites developed in cooperation with the educational community and other amateur satellite groups.





Radio Amateur Satellite Corporation (AMSAT-NA)
850 Sligo Ave., Silver Spring, MD 20910-4703
Telephone: 301-589-6062 – Toll Free: 888-322-6728
Facsimile: 301-608-3410
AMSAT-NA Club Callsign: W3ZM
AMSAT-NA Web site: <http://www.amsat.org>

The AMSAT Journal Staff

Editor-in-Chief: Ed Long, WA4SWJ, wa4swj@amsat.org
Assistant Editor: Bill Hook, W3QBC, w3qbc@amsat.org
Assistant Editor: JoAnne Maenpaa, K9JKM, k9jkm@amsat.org
Circulation: Martha Saragovitz, martha@amsat.org

AMSAT-NA Board of Directors

Barry Baines, WD4ASW, wd4asw@amsat.org
Alan Biddle, WA4SCA, wa4sca@amsat.org
Tom Clark, K3IO, k3io@amsat.org
Drew Glasbrenner, KO4MA, ko4ma@amsat.org
Lou McFadin, W5DID, w5did@amsat.org
Tony Monteiro, AA2TX, aa2tx@amsat.org
Gould Smith, WA4SXM, wa4sxm@amsat.org

AMSAT-NA Senior Officers

President: Barry Baines, WD4ASW
Executive Vice-President: Open
Treasurer: Keith Baker, KB1SF/VA3KSF
Secretary: Alan Biddle, WA4SCA
Manager: Martha Saragovitz
Vice-President, Engineering: Tony Monteiro, AA2TX
Vice-President, Operations: Drew Glasbrenner, KO4MA
Vice-President User Services: Gould Smith, WA4SXM
Vice-President Human Spaceflight: Open
Vice President, Marketing: Open

Honorary Positions

Immediate Past President: Rick Hambly, W2GPS
President Emeritus: Tom Clark, K3IO
Founding President: Perry Klein, W3PK

Editorial Office: Ed Long, WA4SWJ, 4420 SE 106TH ST, Belleview, FL, 34420-6835. Please e-mail Journal submissions to: journal@amsat.org. Editor's telephone: 262-374-1349 (cell). Advertising Office: AMSAT-NA Headquarters, 850 Sligo Avenue, Suite 600, Silver Spring, MD 20910-4703, Telephone: 301-589-6062.

The AMSAT Journal (ISSN: 1407-3076) is published bi-monthly (Jan/Feb, Mar/Apr, May/Jun, Jul/Aug, Sep/Oct, Nov/Dec) by AMSAT-NA, 850 Sligo Avenue, Suite 600, Silver Spring, MD 20910-4703. Telephone: 301-589-6062, fax: 301-608-3410. Periodicals postage paid at Silver Spring, MD and additional mailing offices.

Postmaster: Send address changes to *The AMSAT Journal*, 850 Sligo Avenue, Suite 600, Silver Spring, MD 20910-4703.

Opinions expressed in *The AMSAT Journal* are those of the article authors and are not necessarily those of AMSAT-NA. Copyright © 2010 by AMSAT-NA. The Radio Amateur Satellite Corporation. AMSAT is a registered trademark. Reproduction of material from *The AMSAT Journal* by mechanical, electronic, photocopy or other means is prohibited unless written permission is obtained from the author.

The AMSAT Journal staff is always interested in article submissions. Whenever possible, submissions should be sent via e-mail to journal@amsat.org using plain text or word processor files; photos or figures in TIF, GIF or JPEG formats. Kindly do not embed graphics or photos in your manuscript - we prefer receiving those as separate files. AMSAT-NA reserves the right to select material for *The AMSAT Journal* based on suitability of content and space considerations. The editors of this publication are volunteers giving freely of their talents, time and efforts to produce *The AMSAT Journal*.

Since I wrote my last Apogee View column back in August, a number of accomplishments have taken place. Some of these I highlighted during the AMSAT Annual Meeting that took place on Saturday, October 9, which was live on EchoLink. A copy of my presentation is also on the AMSAT Web site. At this point I'd like to discuss recent developments since Symposium.

ARISSat-1/Radioskaf-V

Several significant milestones have been met in the past month:

- a. The flight unit successfully completed vibration testing in Orlando. That unit, along with a backup unit (which doesn't have solar panels) were crated and subsequently shipped to Johnson Space Center, Houston for furtherance to Moscow. NASA is coordinating shipping arrangements with Energia.

Currently, we are awaiting confirmation from RSC-Energia that the appropriate paperwork has been prepared by them for acceptance of the ARISSat-1 by Russian Customs. Once this paperwork has been received by NASA, the satellite will be physically shipped to Moscow from Houston.

- b. The NASA Phase II Payload Safety Review Panel (PSRP) met on October 12-13 to review the ARISSat-1 Safety Data Package. Energia representatives also participated. ARISSat-1 Engineering Team leaders were on the conference call and Lou McFadin, W5DID, led the presentation given by the team to the panel. The two-five hour conference calls provided an opportunity for the panel to thoroughly review the ARISSat-1 design and address any concerns that they had concerning hazard mitigation. As a result of these meetings, AMSAT must revise some documentation to clarify some concerns, but the tone and tenor of the meetings made it clear that the PSRP was satisfied with the design of the satellite. Revised Safety Hazard Report documentation will be submitted to the panel shortly.
- c. RSC-Energia has invited an AMSAT representative to travel to Moscow to be present for integration of the Kursk Experiment and installation/checkout of the Russian-supplied Orlan Suit silver zinc battery. Lou McFadin, W5DID, will travel to Moscow to assist with the

integration. Lou will be accompanied to Moscow by Mark Steiner, K3MS, of NASA Goddard Space Flight Center. They are currently scheduled to be in Moscow the week of December 6.

- d. A Phase III Payload Safety Review is scheduled for mid-December following integration of the Kursk experiment and testing of the satellite with a Russian-provided silver zinc battery in Moscow. Additional input for the Safety Data Package regarding the silver zinc battery, integration results and other details will be provided by RSC-Energia.

With completion of the flight and backup flight units (both being shipped to Russia), the focus is now on completing units 3 and units 4 in the next few weeks. These units will be placed in storage with the expectation they may be used for future flight opportunities.

Likewise, with the expected deployment of the ARISSat-1/RadioSkaf-V in late February, we are also shifting our focus toward publicizing ARISSat-1 to the Amateur Radio and educational communities. ARISSat-1/Radioskaf-V hosts a number of educational features, including prerecorded messages for students to receive, telemetry of the spacecraft and the Kursk experiment data to download and analyze, and SSTV images to view and enjoy. Along with this orbiting Amateur Radio experiment, AMSAT is developing ground station software that will be available prior to ARISSat-1 deployment that will be capable of decoding and displaying satellite telemetry transmitted in the new BPSK-1000 mode and download the BPSK-400 secondary telemetry format. The new BPSK-1000 format was developed by Phil Karn, KA9Q, for ARISSat-1/Radioskaf-V. Users will also need to download and install software for SSTV reception.

The Amateur Radio community needs to be made aware of the Amateur Radio capabilities of this satellite, including the 16 kHz-wide transponder, the CW beacon which will feature telemetry, the spacecraft callsign (RS01S) and callsigns of those making valuable contributions to the

continued on page 22 ...



Getting Started on the Amateur Radio Satellites (Part II)

by Keith Baker, KB1SF/VA3KSF, kb1sf@amsat.org

(The bulk of this article was previously published as "Working Your First Amateur Radio Satellite (Part II)" in the February 2010 issue of *Monitoring Times*, Brasstown, NC 28902)

Greetings and welcome once again to the Beginner's Corner of *The AMSAT Journal*! My goal in this series of articles is to help beginning satellite operators (or would-be beginners!) demystify the world of Amateur Radio satellites by sharing a wealth of practical information about how to listen for (and work through) our ever-expanding fleet of OSCARs (Orbiting Satellites Carrying Amateur Radio). I'll be examining some of those satellites currently in orbit as well as those that are still on the drawing boards or are now being prepared for launch.

I trust my first article in the July/August issue of *The AMSAT Journal* served to "whet your appetite" about how to listen for and use these largely "home brewed", modern-day wonders constructed from aluminum, silicon, glass and other electronic components that a lot of people have labored long and hard to put into orbit (and then command) for our use. However, before you progress further, there are a few more considerations and "tricks of the trade" that I need to share with you so that your attempts at hearing or working through one or more of our so-called "EZ Sats" will be more successful.

Some Additional Handheld Antenna Considerations

First, let me say it right up front: In satellite work, your antennas are, without a doubt, *the* most important part of your station. That's because the power output of the majority of amateur satellites now in orbit seldom runs more than a watt or two. Indeed, two of the satellites I mentioned in my previous article ... AO-51 and AO-27 ... normally transmit with a power output of only about ½ watt or so. The power output of SO-50 is even lower.

What's more, *all* of these satellites transmit into either a single, quarter wave whip or what's called a "turnstile" antenna array that usually consists of a set of four; quarter-wavelength 2m or 70cm whips canted inward (or outward) at a 45-degree angle on the bottom of the spacecraft. But, unfortunately, even with their multiple elements, the nominal gain of these arrays is still pretty close to zero. The end result is that most of these satellites are transmitting

with little more than "flea power" into a proverbial "wet noodle" for an antenna. And if transmitting with low power wasn't enough of a hurdle to overcome, it is important to remember that most of our satellites are in what we call a Low Earth Orbit (LEO). This means that the bulk of them will never be closer to you than about 500 miles (800 km) even when they are directly overhead. And they'll be over 2,000 miles (3,200 km) distant when they are near the horizon.

So, it should go without saying that you *will* need a good receiver and some sort of gain antenna in your setup to reliably hear them. And, as you might guess, the "rubber duck" antennas that usually come supplied with most handheld radios are simply *not* large enough to routinely hear or communicate through these satellites, except under absolutely ideal conditions. By "ideal" I mean with the satellite located almost directly overhead and with just a few other people using the transponder.

The Harsh Environment of Space

Another consideration that has to be taken into account has to do with the harsh environment of space where our satellites operate. For example, when their solar panels

are in full sunlight, these satellites are being "baked" at about 250 degrees Celsius. When they go behind the Earth and out of direct sunlight, the external temperature of these satellites rapidly cools down to a temperature near *minus* 250 degrees Celsius! Needless to say, such rapid temperature swings would soon destroy the fragile electronics onboard if something weren't done to move heat around inside the spacecraft.

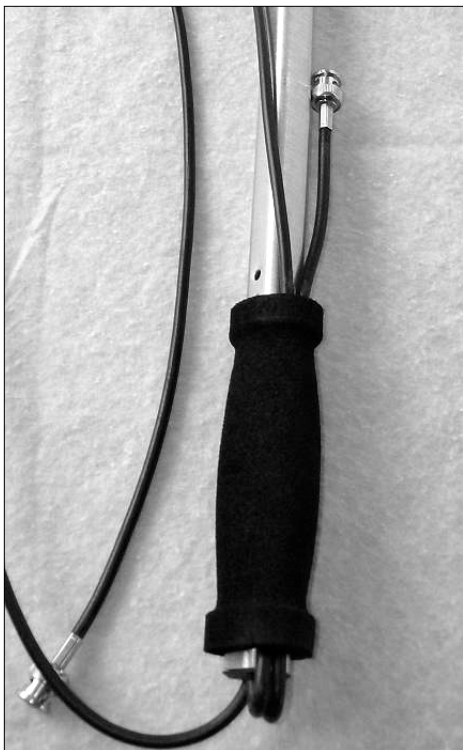
As we all know, high temperatures can very easily destroy the modern semi-conductor components in our equipment. That's why most modern ham transceivers come equipped with a fan or metal heat sink of some sort. However, it's important to remember heat sinks and fans are both designed to work with *air*. Unfortunately, there's *no* air in space to cool such components in the same way as we do on Earth. So, it goes without saying that our satellites need to dissipate all of that blistering excess heat they get from the Sun in some other way.

Likewise, such things as batteries do not operate *at all* well in the cold. Anyone who has tried to use a modern digital camera outside in sub-zero temperatures knows that you have to keep several sets of batteries in



The author's satellite "hand shack" consists of an Arrow Model 146/437 antenna and a Kenwood TH-78A dual band handi-talkie (HT). The antenna easily breaks down into several pieces for easy transport. (KB1SF Photo)





The Arrow sports a 2m/70cm 10W duplexer tucked inside the handle under a removable foam grip. This allows for a single feed line to connect the antenna to a “rubber duckie” connection on a handheld radio. (KB1SF Photo)

a warm pocket or two if you ever hope to capture more than one or two photos under such conditions.

So, with them baking inside a metal box at 250 degrees Celsius in full sun (and then freezing at *minus* 250 degrees during eclipse) just imagine what our satellite batteries and other electronic components go through *on each and every orbit!* That’s why our AMSAT satellites (and, indeed, most others) are all designed to spin about their vertical axis (much like a barbeque rotisserie does) as they orbit the Earth. This motion helps to move heat and cold around in the innards of the satellite evenly (usually by direct thermal contact of internal components to the space frame) so as to keep the batteries and other electronics inside the satellite heated and cooled within their proper operating parameters.

This is also one of the main reasons why simply sticking a couple of cheap, off-the-shelf, VHF/UHF ham transceivers into a metal box powered by some surplus store nickel-cadmium batteries, adding a bunch of solar panels and then mounting the whole thing on a rocket and launching it often results in a highly unreliable satellite. While such “cobbled together” satellites *may* work

in orbit for a time, they usually don’t work for very long!

Doing the Tumble

Furthermore, to keep their downlink antennas properly oriented toward the Earth, most of these birds are *also* designed to slowly tumble end over end as they move from South to North (or North to South) over the planet. While also contributing to balancing out those rapid heating and cooling cycles caused by the Sun’s radiation, this tumbling motion also helps keep what meager gain their transmit antennas are radiating pointed back down toward the Earth and us.

Unfortunately, this constant tumbling motion means that the polarity of the satellite’s receiving and transmitting antennas will be constantly changing as it moves overhead. And, as satellite work is “line of sight” work, unless you are able to change your antenna’s polarization in sync with the satellite, its downlink signals will undergo some very deep fades in your receiver due to severe (sometimes as great as 5 or 6 dB) antenna cross-polarization effects during the course of the satellite’s pass.

So, while they *will* work for “hit and miss” satellite contacts, my experience has shown that most fixed and mobile vertical antennas are simply not good enough to overcome these limitations. That’s because they usually cannot be easily (or rapidly) tilted to match the ever-changing polarization of a satellite’s

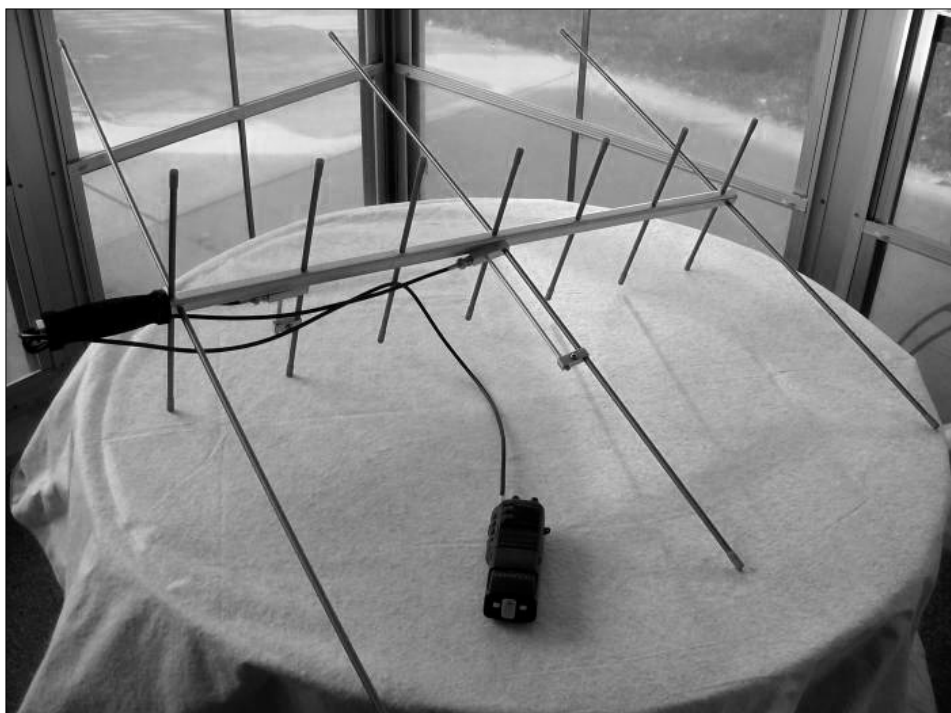
transmit and receive antennas as it tumbles across the sky.

For this same reason, quarter-wavelength and 5/8-wavelength HT-mounted whips are *also* not recommended for such activities, either. Besides being frequently cross-polarized with the satellite’s antennas, most handheld radios simply don’t provide the required ground plane for such antennas to be fully effective.

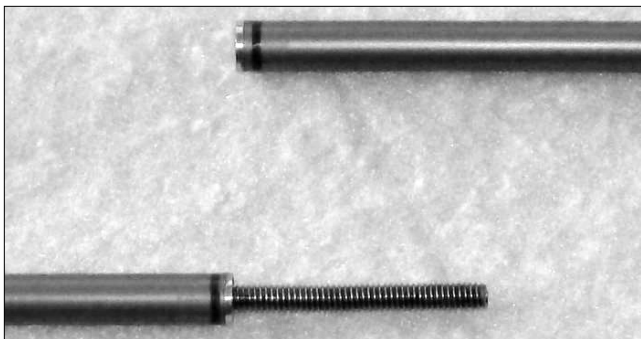
And, finally, because the downlink signal strength of most of these satellites *is* so weak to start with, most scanners (or other, so-called “broad band” receivers that cover 145 or 436 MHz) will usually not be able to reliably receive the downlink with just a whip antenna (even an external one!) because their unamplified receiver gains usually aren’t high enough to do so.

The bottom line here is that, no matter how you cut it, satellite work *is weak signal work*. And while little whips and “rubber duckie” antennas are fine for most terrestrial applications, they usually don’t provide enough downlink gain to be useful for reliable weak signal satellite work beyond casual “hit and miss” contacts.

However, before you say, “I’ll never be able to get on the birds” and give up in disgust, let me also say that with the creative addition of a set of small (and relatively inexpensive!) Yagi antennas to produce a bit more uplink and downlink gain, your HT *can* be turned



The author’s assembled Arrow Antenna with Kenwood TH-78A HT attached. (KB1SF Photo)



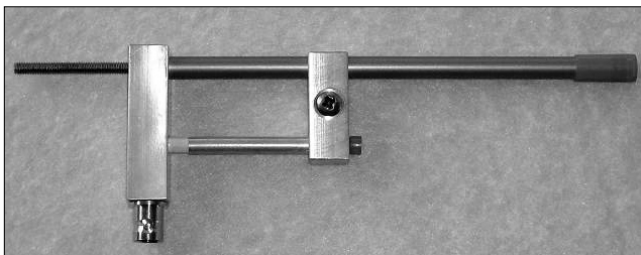
The Arrow's elements are nicely machined from aluminum arrow shafts ... hence the name. Threaded elements easily slip through the boom to provide a secure connection to its opposite element on the other side. (KB1SF Photo)

into a very effective Earth station for use with these satellites.

Handheld Yagis to the Rescue!

As I have said, if you are truly serious about routinely hearing or working through our FM birds with an HT, a hand-held Yagi antenna of some sort will be needed to provide your transceiver with enough effective uplink power (and downlink receiver gain) to reliably do so.

Over the years, many amateur satellite enthusiasts have "rolled their own" hand-



The Arrow features beautifully machined gamma-matching stubs for both the 2m and 70cm feeds. The 70 cm feed stub is shown here. (KB1SF Photo)

held Yagi antennas exclusively to work these LEO satellites. For example, radio hams like long time VHF enthusiast Kent Britain, WA5VJB, have been freely sharing their learning by publishing numerous plans on the Internet for a series of "home brewed" hand held Yagis for 2m and 70cm made out of easily obtainable materials. These materials include pieces of aluminum ground wire or brazing rod along with scraps of lumber from your basement, garage or shed (or, when all else fails, from your local hardware store.)

In an excellent online article he's dubbed *Cheap Antennas for the AMSAT LEO Satellites* at www.oh1sa.net/data/satellite/antenna-lna-etc/Cheap_Antennas-LEOs.pdf, Kent shows how you can easily build a dual band hand-held Yagi to work the

hand-held satellite antennas for LEO satellite enthusiasts. Antennas such as the commercially manufactured Arrow Model 146/437-10 dual-band handheld beam antenna (sidebar) or the Elk Antenna Model 2m/440L5 (available either from Martha at the AMSAT-NA office or via www.elkantennas.com) are highly recommended commercial substitutes. Both of these antennas will provide more than enough gain for you to work the FM satellites with a 3-5 watt output, dual-band HT or to hear them with a handheld VHF/UHF scanner.

Other Helpful Operating Hints

As I have said, it is important to remember that when you attempt to communicate through them, these satellites will be both spinning and tumbling in orbit, so their uplink and downlink antenna polarizations will be constantly changing. If you are using a whip antenna on an HT just to try and listen for one of them, moving your HT around a bit during the satellite pass may be helpful. That motion should result in your (and the satellite's) antenna polarizations (briefly!) meeting up at some point. I've also found that reflections from conductive surfaces (such as a car body) will sometimes help improve your received and transmitted signals as well.

As I also noted in my feature article in the July/August edition of the *Journal*, if you are using an HT, you'll also want to

FM birds. Another reliable source of plans for these "home brew" antennas can be found in an excellent series of beginner articles on our own AMSAT-North America Web site at www.amsat.org/amsat-new/information/faqs.

However, if building your own antenna from scratch isn't your thing, fortunately there are at least a couple of commercial manufacturers who offer

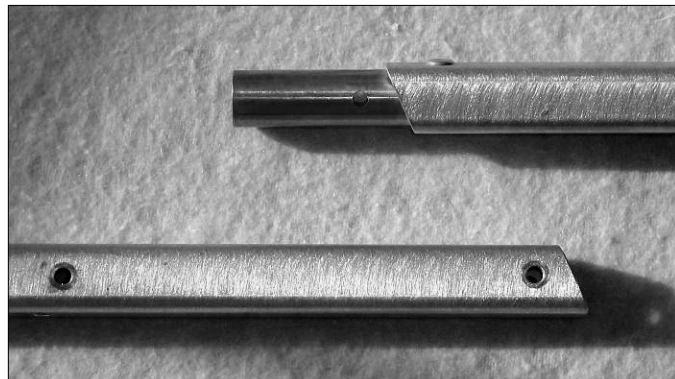


Removing the duplexer and foam grip reveals screw holes for mounting the Arrow Antenna on a lightweight photo tripod. (KB1SF Photo)

use a speaker-mike (or better yet, a headset with a boom mike attached) while working through these satellites.

A boom headset will free you from the task of having to hold an antenna in one hand and your radio near your mouth and ears with the other. Believe me, even though they are made from lightweight materials, your arm *will* get tired after holding one of these antennas for a 15 minute satellite pass ... so much so that you will probably want to switch hands a time or two during your contact. Another approach that works well is to enlist the aid of an assistant who can hold your radio (or a small external speaker connected to your HT) during the pass.

As I also noted in my previous article, another very good reason for using some form of speaker microphone or boom headset is that if you are communicating through the satellite using a full-duplex HT,



An optional version of the Arrow sports a tight fitting, split boom feature. (KB1SF Photo)



Craig Wolsey, AC8EJ/VA3ICW, uses his HT and Elk Model 2M/440L5 antenna to make a contact through AO-51 from the shores of Lake Huron in Canada. The antenna's unique log periodic design allows for dual band operation using just five elements connected to a single feedline and without the need for a duplexer. (KB1SF Photo)

having your microphone and speaker so close together in the same unit will usually create howls of audio feedback ... *through the satellite* ... when you transmit! Again, such activity will NOT make you a popular “camper” on the bird!

What's more, because they are so weak, AO-51, AO-27 and SO-50 downlink signals are unlikely to be strong enough to trip the squelch on most FM receivers. So, be sure to open your receiver's squelch all the way (until you hear the rushing sound) before you begin listening. When the satellite comes into range of your location, the rushing sound will “quiet”, giving you a clear indication that you have, indeed, “captured” the bird's downlink.

Swimming with Alligators

Speaking of capturing signals, it is also important to remember that, because FM signals exhibit a very definite capture effect, there will be times when there are so many people trying to use the bird that you simply won't be able to get into the transponder no matter how hard you try. And you will also occasionally encounter high-powered, so-called “alligators” on the birds. These are people who routinely operate with “all mouth and no ears” and, in the process, end up hogging the bird's FM uplink.

If this happens, just keep trying to drop your call sign in between their transmissions. Or, failing that, simply try again on another pass

when, hopefully the “alligators” will be out of the satellite's footprint ... or out to lunch! I've had the best luck on these satellites with my HT and Arrow during less busy, mid-week passes where the maximum elevation angle to the satellite from my location was at least 30 degrees above the horizon.

Also, if you're fortunate enough to be operating from a location within a few hundred miles of an ocean coast, you may find it easier to get into these satellites with low power when the bird is out over the ocean than when it's passing over, say North America or Europe. That's because there will be fewer stations within the footprint to compete with you at that time, and most of those competitors will be farther from the satellite than you are.

What if I Don't Hear The Satellite?

This has happened to all of us at times, so *don't* give up! Go back and re-check the satellite's operating schedule at www.amsat.org/amsat-new/satellites/status.php to be absolutely sure you are listening and transmitting on the correct frequencies. Another culprit may be that your tracking software is providing you with erroneous pass data. Double check your satellite tracking program to be sure that you have a fresh set of Keplerian elements loaded, that your location file (station latitude and longitude or Maidenhead Grid Square entry) is correct and that you *also* have the proper

More on Antennas

The Arrow II Satellite Antenna Model 146/437 provides an impressive forward gain of approximately 10.3 dBd at 70 cm and 4.6 dBd at 2 meters. Sturdily machined from aluminum arrow shafts (hence the name), this antenna actually consists of two antennas mounted at right angles to each other on the same boom ... a three element Yagi for 2m and a seven element Yagi for 70cm. A removable foam handgrip and threaded horizontal and vertical photo tripod mounting holes underneath the handgrip make this totally collapsible antenna also useful for terrestrial radio direction finding or portable emergency work.

Options include a split boom and a removable 10-watt (max.) duplexer inside the boom along with an assortment of cloth carry bags. With prices starting at about US \$75 (minus the split boom and duplexer options) the antenna has, quite literally, spawned a whole new way for thousands of hams worldwide to work the “birds”.

I actually own two of these split-boom and duplexer-equipped Arrow antennas and I remain absolutely delighted with their performance. One of them, along with my Kenwood TH-78A handi-talkie (HT), goes with me in my vehicle or suitcase whenever I travel. Using my Arrow and my HT, I've been able to consistently work thorough AO-27 and SO-50 down to about 10 degrees elevation. I've also heard and worked AO-51's half-watt transmitter nearly all the way out to the horizon.

Several Amateur Radio dealers offer various versions of both the Arrow and Elk Antennas in their catalogs or they can be ordered directly from their respective manufacturers (www.arrowantennas.com or www.elkantennas.com).

Right now, the Elk antenna is also available in limited quantities via telephone order from Martha at the AMSAT office with the proceeds going to benefit AMSAT. You can call Martha toll free from the US or Canada at 888-322-6728 (or 301-589-6062 elsewhere) to order yours today!





An optional carry bag keeps all the disassembled Arrow elements together for easy transport. There is also a bag available for the Elk antenna. (KB1SF Photo)

GMT versus local time offset loaded into the software. And don't forget to take into consideration Daylight Savings Time at your location.

It is also important to remember that transponder schedules and pass times for these satellites are all expressed in GMT and will vary from day to day ... that's why you need computer software to track them. I can't begin to tell you how many times I've gone outside to work one or more of these satellites only to find I was listening for them at the wrong time or on the wrong frequency! All of which simply proves that even former AMSAT presidents (like me) are *well* capable of falling victim to such simple errors!

For best results, your software's uploaded Keplerian Element files (I also briefly discussed Keplerian Elements in my previous article) should be updated at least once a month. If you don't already have a computer tracking program, check out the software tracking page on the AMSAT web site at www.amsat-na.com/store/category.php?c=Software and obtain a copy of their SAT-PC32 software. For a small monetary donation to AMSAT, the software can be obtained either via download from our Web site or via CD-ROM directly from Martha

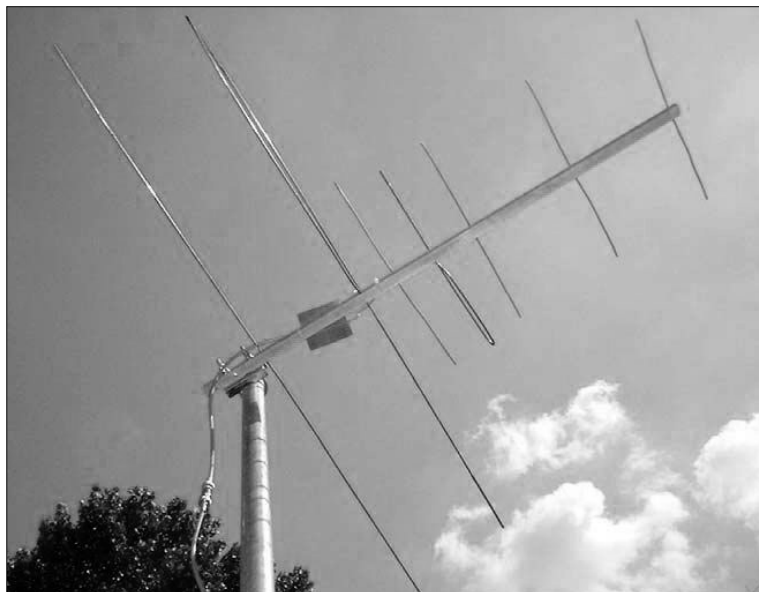
at AMSAT Headquarters.

What's more, the AMSAT Web site sports an online tracking display at www.amsat.org/amsat-new/tools/predict/satloc.php?lang=en&satellite=AO-51 for a number of AMSAT satellites (including AO-51, AO-27 and SO-50). Use the drop down box under the map display to select the satellite you wish to track. I routinely use it as a quick cross-reference to what my computer's tracking software is displaying to make sure I have everything in my computer set correctly. The orbital position of the

satellite you are tracking with your computer software should roughly match what's being displayed online by AMSAT.

Looking Ahead

By the time we next meet, I hope to have contacted many of you on one of our EZ Sats. In future columns I'll be discussing some innovative ways to optimize your base station antennas and feed lines to work the birds from inside your "shacks", as well as to pass along some other "tricks of the trade" to make your beginning satellite contacts more frequent and enjoyable. See you then! 🌐



Kent Britian's "Cheap LEO" antenna uses aluminum ground wire and bronze welding rods for elements. The boom is made of wood. (Courtesy: WA5VJB)



AMSAT board of directors member Drew Glasbrenner, KO4MA, works the birds using one of Kent Britain's "Cheap LEO" antennas. (Courtesy: WA5VJB)



An ARISSat-1 Overview

by Tony Monteiro, AA2TX, aa2tx@comcast.net
and Gould Smith, WA4SXM, wa4sxm@amsat.org



Introduction

On Monday October 4, 2010, Lou McFadin, W5DID, drove his Chevy Suburban to our Orlando Satellite Construction Facility (*also known as K4RSV George's garage*) picked up the completed ARISSat-1 satellite, and drove it to Essential Air Services where it was packed into a wooden crate. This

capabilities.

ARISS and SuitSat

The Amateur Radio on the International Space Station (ARISS) program is an international effort staffed by volunteers. It is intended to promote space education and inspire an interest in science, technology, engineering and math (STEM) through

provided science experiments. It would also provide the opportunity to fly an improved radio communications system employing an experimental software defined transponder (SDX). To provide a longer life, solar panels and a power system would be used to recharge its battery.

Alas, in July of 2009 with SuitSat-2 development well under way, the engineering team hit a major road block. Due to the need for more *space* on the ISS, the surplus Orlan space suit had to be discarded. RSC-Energia informed ARISS that they were still willing to provide the upmass launch on a Progress rocket to the ISS and the EVA (extra-vehicular activity *a/k/a/ a spacewalk*) to deploy it, but the satellite would need its own spaceframe. With this new development, the engineering team began in earnest to design and construct a new spaceframe along with re-working the previously designed modules and subsystems to go with it. The new satellite was named ARISSat-1.

The ARISSat-1 System

The new ARISSat-1 satellite consists of several subsystems and modules mounted to an aluminum spaceframe as shown in the drawings of Figures 1 and 2. The subsystems include six solar panels, a maximum power point tracker (MPPT) module, a battery, a control panel, four slow-scan television cameras, the Kursk science experiment, a 2 m whip antenna, a 70 cm whip antenna, an RF module and an Internal Housekeeping Unit (IHU.) These modules are interconnected as shown in Figure 3. Modules on the left side of the drawing are on the outside of the spaceframe structure while those on the right are inside.

The six solar panels were donated to the project from NASA. They were left over after the Small Explorer (SMEX) satellite program ended. Each panel measures 19-inches by 10.5-inches and consist of 50 cells. In full sunlight, each panel can produce about 50 volts open-circuit and over 19 watts of electrical power. A panel is mounted on each of the six surfaces of the spaceframe.

Each solar panel is connected to a maximum power point tracker circuit inside the MPPT module. These circuits are DC to DC power converters that are designed to draw the maximum power available from each solar panel to drive the satellite's +28V main

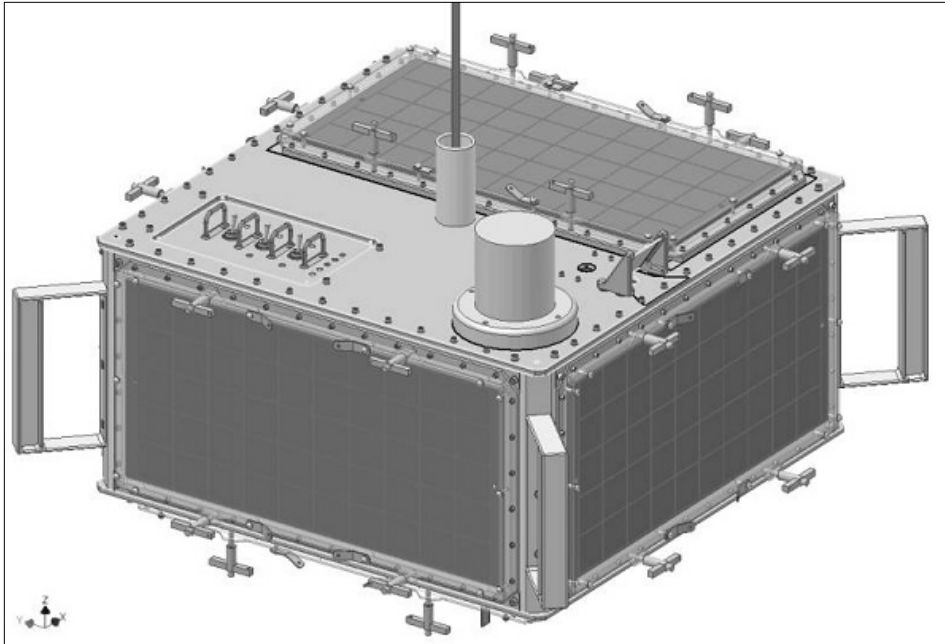


Figure 1: ARISSat-1 external view.

humble trip marked the beginning of its long journey into space.

The satellite was shipped from Orlando to the NASA Johnson Space Center in Houston, TX. From there, it will travel to Moscow where the Kursk University science experiment will be added and final tests will be performed. And then it will be off to the Baikonur Cosmodrome where it is to be launched on a *Progress* spacecraft to the International Space Station (ISS.) Once on board, the flight battery will be installed and finally, it will be taken through the airlock by a pair of cosmonauts and released into earth orbit.

The completion of this satellite is the culmination of four years of effort and represents the work of over 50 AMSAT volunteers working in conjunction with NASA, RSC-Energia (the Russian space agency) and ARISS-International. This overview is the first in a series of articles planned for *The AMSAT Journal* that will describe the ARISSat-1 systems and

Amateur Radio activities on the ISS.

The first ARISS space education satellite was SuitSat; deployed on February 3, 2006. SuitSat caused an international sensation and was perhaps the most unusual satellite ever devised. It consisted of a radio transmitter mounted to the helmet of an old (empty) Russian *Orlan* space suit. Pre-recorded voice greetings from students around the world were to be played through the transmitter on the 2 meter ham band. Unfortunately, the transmitted signal from SuitSat proved to be very weak and only a few sophisticated ground stations were able to receive it. After about two weeks in orbit, the batteries failed ending its operation.

In November of 2006, a new version of SuitSat was initiated. The intent was to again use an old Russian space suit as the satellite spaceframe but with significant technical improvements. The new satellite, dubbed SuitSat-2, was to be developed using modular, re-usable sub-systems and would provide a platform for flying student



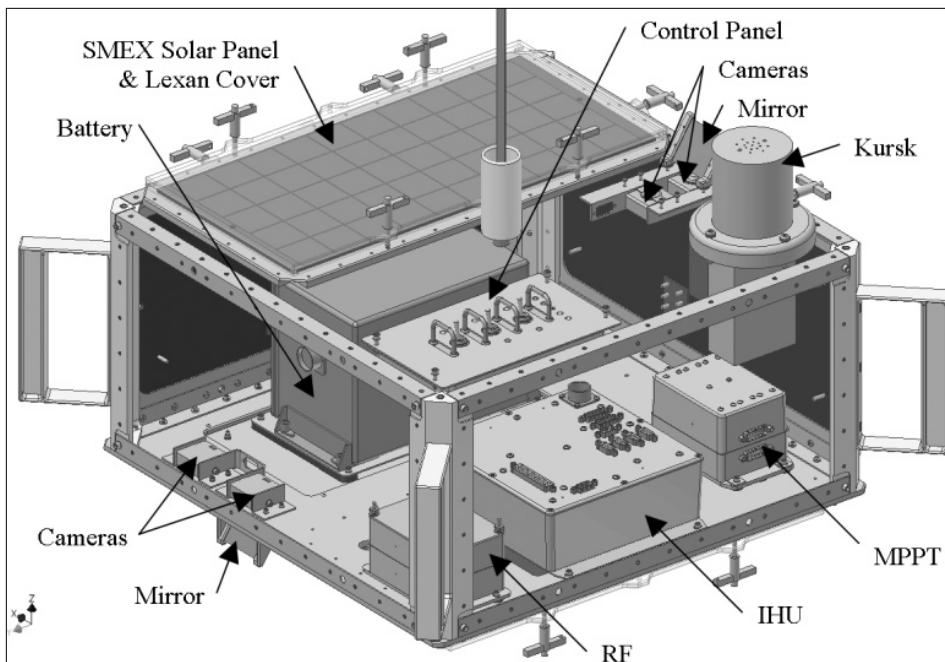


Figure 2: ARISSat-1 cutaway view.

power bus. The main power bus is directly connected to the battery. To prevent overcharging the battery, the maximum voltage from the MPPTs is limited to approximately 36 volts.

The battery was donated to the project by RSC-Energia. This is a type 825M3 and is the exact same type used to power the Russian Orlan space suit. It internally consists of eighteen, rechargeable silver-zinc (AgZn) cells and is specified for 14 ampere-hours at 28 volts. In sunlight, the solar panels and MPPT circuits will run the satellite and charge the battery and in eclipse, the battery provides the power to run the satellite.

To meet the ISS safety requirements, the control panel keeps the battery and solar

panels from powering the satellite until it is ready for deployment. The control panel, shown in Figure 4, provides an interface that a cosmonaut can comfortably operate while wearing a space suit. It has three switches separated by finger guards so that only one switch at a time can be activated. All three switches must be turned on to power-up the satellite. A set of LEDs provide the satellite operational status. After all three switches are turned on, a safety timer circuit prevents any RF transmissions for 15 minutes. This is to prevent the RF transmitter on ARISSat-1 from causing a hazard by interfering with the space suit electronics.

While ARISSat-1 cannot transmit a signal for 15 minutes, it does actually power up

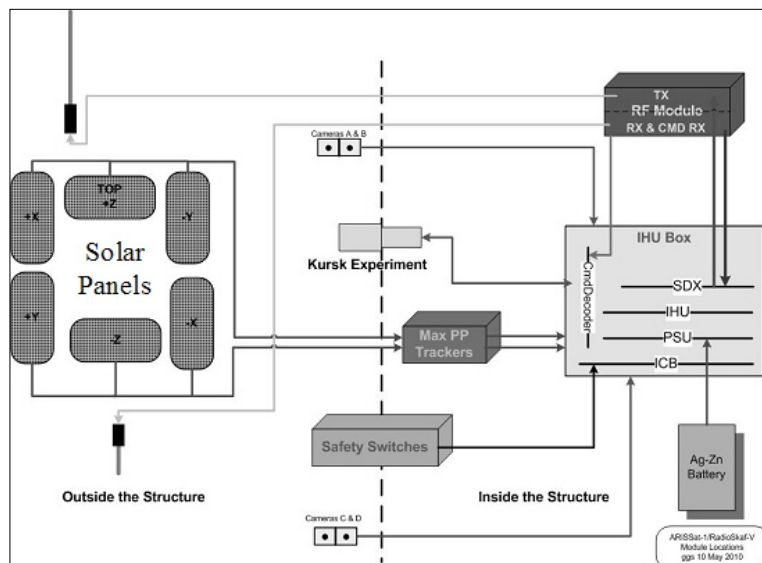


Figure 3: ARISSat-1 system diagram.

and take several snapshots with its SSTV cameras soon after the switches are turned on. It saves these photos in its internal memory for transmission throughout its first day in orbit and it is hoped that it can catch a glimpse of the cosmonauts or the ISS as it is being deployed. There are a total of four cameras on ARISSat-1 with mirrors to set the field of view of two of the cameras. They point up, down, and to opposite sides of the satellite. A new set of snapshots are taken about every two minutes and saved in memory for transmission with very dark or blank images discarded. There are also several pre-recorded images that are sent when the satellite is in eclipse (i.e. darkness). One of these images showing the call sign (RS01S) can be seen in Figure 5. The pictures are transmitted in color using Robot 36 format.

To the right of the control panel on the top plate, as shown in Figure 2, is the Kursk science experiment. This experiment was developed by students at the Kursk State University in Russia and is intended to measure the vacuum of space. The experiment is started 30 minutes after deployment and will run once each day for a complete orbit. It should be possible to measure the differences in vacuum pressure as the satellite slowly descends into the upper part of the earth's atmosphere. A photo of the Kursk experiment can be seen in Figure 6.

Also mounted on the top plate, in the center, is the 2 m whip antenna. The base of this antenna can be seen in the drawing of Figure 1. ARISSat-1 has a 70 cm whip antenna as well that is mounted on the bottom plate though it is not visible in the drawing. These antennas are connected to the RF module.

The RF module has a 2 m communications transmitter and produces a total of 500 milliwatts of power. The input to the transmitter is a 10.7 MHz intermediate frequency (IF) signal that is generated in the IHU. The RF module also has a 70 cm band communications receiver and its output is a 10.7 MHz IF signal that is fed to the IHU. Additionally, the RF module includes a 70 cm command receiver which provides demodulated audio to the IHU. This receiver is only intended for ground control of the satellite.

The internal Housekeeping Unit (IHU) is perhaps the most complex module in the system and includes several internal circuit cards with a total of five microprocessors. The IHU module diagram is shown in Figure

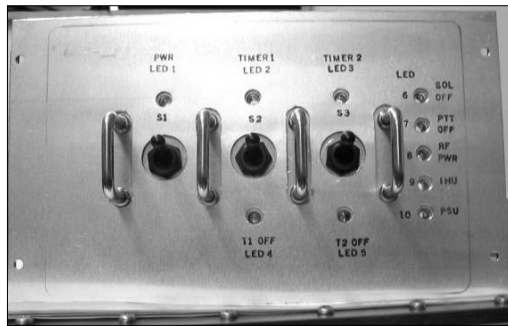


Figure 4: Control panel.

7. The Power Supply Unit (PSU) shown at the top of the drawing converts the +28 volts from the battery and MPPT module to the +5, +8, and +12 volts needed by the other IHU circuits. The main IHU processor is a PIC32MX as shown in the center of the diagram. This processor provides the overall command, control and telemetry for the satellite. It also does the video processing for the SSTV cameras and controls the Kursk experiment operation. A second PIC32MX processor performs the software defined transponder (SDX) functions. All of the radio signals transmitted from ARISSat-1 are generated in software.



Figure 5: SSTV call sign.

These radio signals and their frequencies are shown in Figure 8. The 70 cm band is used for the uplink of a mode U/V (a/k/a mode B) transponder. The 2 m down-link signals include the transponder output, a digital BPSK Telemetry beacon, a CW beacon and FM audio. The transponder is a linear, inverting type and provides 16 kHz of bandwidth. It is very sensitive and should be workable with QRP equipment and omni-directional antennas. The digital BPSK beacon provides satellite telemetry and the Kursk experiment data. The beacon can operate in either legacy BPSK-400 mode or a new BPSK-1000 mode that was specifically developed for ARISSat-1. The new mode includes forward error correction and interleaving and should provide error-free reception using even simple antennas. A companion sound

card based telemetry decoding program is currently being developed for PC and Mac computers. The CW beacon has the satellite call sign (RS01S,) telemetry data and the Amateur Radio call signs of instrumental ARISS and ARISSat-1 program contributors. There are over 200 call signs - see if you can collect them all! The FM audio signal has the satellite call sign, spoken telemetry, the SSTV image signals and voice greetings collected from children throughout the world. There are 24 different greetings in 15 languages and there is a special recording from Yuri Gagarin.

Launch

ARISSat-1 is scheduled for deployment from the ISS on a *manned* spaceflight mission so it must meet very stringent safety requirements that go well beyond that normally required of a satellite. A NASA safety panel, with participation from RSC-Energia and AMSAT, has already conducted several reviews and has provided guidance on the requirements needed to pass the final review. The final safety review requires the results of testing that is to be done by RSC-Energia and so must be conducted *after* the satellite has been shipped to Moscow.

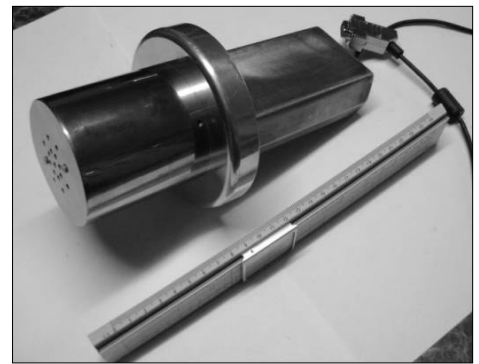


Figure 6: Photo of Kursk experiment.

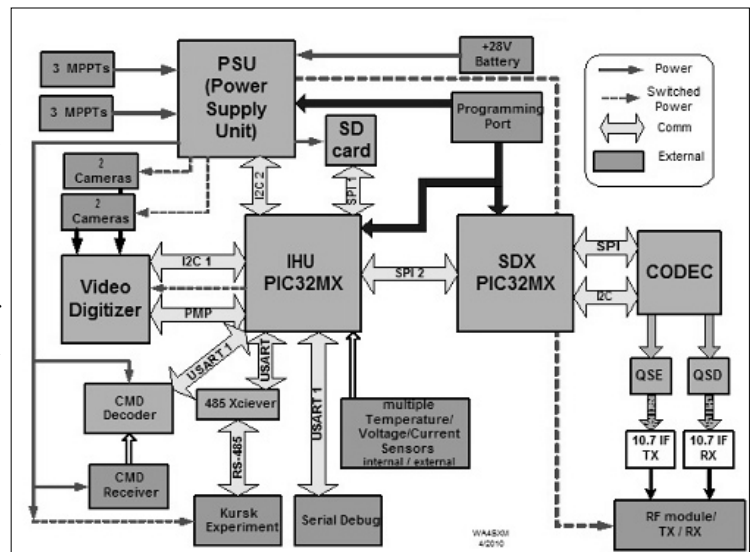


Figure 7: IHU diagram.

ARISSat-1 is currently planned for launch from the Baikonur Cosmodrome in Russia on Progress #41 in January 2011. It is scheduled for deployment from the ISS in February 2011 and should remain in orbit for about one year. 🌐

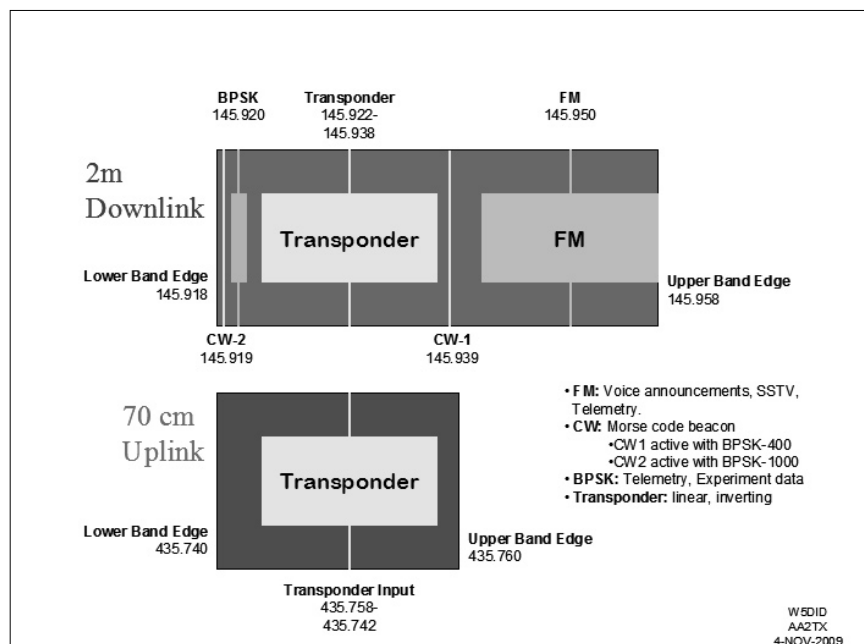


Figure 8: RF band plan.



AMSAT is the North American distributor of SatPC32, a tracking program designed for ham satellite applications. For Windows 95, 98, NT, ME, 2000, XP, Vista, Windows 7.

Version 12.8a is compatible with Windows 7 and features enhanced support for tuning multiple radios.

Version 12.8a features:

- Select 2D/3D map with a single mouse click
- Select Political/Physical map with a single mouse click
- AOS voice announcement
- Countdown program displays next AOS of your favorite satellites
- Automatic Internet download of Keplerian elements.
- Graphical tracking on a world map with two selectable Zoom factors.
- One-click satellite switching using 12 "letter" buttons.
- Automatic rotor control support for: LVBTracker, Kansas City Tracker/Tuner, FODtrack, Uni_Trac, SatEL, Labjack U12/U3/Piggyback, W0LMD Mini/Junior/Senior Trackers, Yaesu GS-232, ARS from EA4TX, EGIS rotors, IF-100, RIF-PC, AMSAT-DL interface, WinRotor32, HalloRotor, and WiSP DDE clients.
- Doppler tuning with on-screen frequency displays. Radio models supported:
Yaesu FT-847, FT-736R, FT-817, FT-857, FT-897
ICOM IC-820H, IC-821H, IC-910H and other ICOM radios
Kenwood TS-790 and TS-2000
DDE client programs
- "Transparent" VFO-knob tuning in addition to keyboard and mouse tuning.
- "Virtual" VFO tracking for half-duplex transceivers FT-817, FT-857, FT-897, IC-706 and IC-7000.
- Includes a special version for ISS split-frequency operation.
- Controls subaudible tone on FT-847, FT-736R, FT-817/857/897, TS790A and IC-910H.
- Includes a non-graphical version and programs that output lists to the screen, printer, or a file.
- Interfaces with WiSP, with user-defined satellite switching priority.
- Includes a separate program for tracking the Sun and Moon.

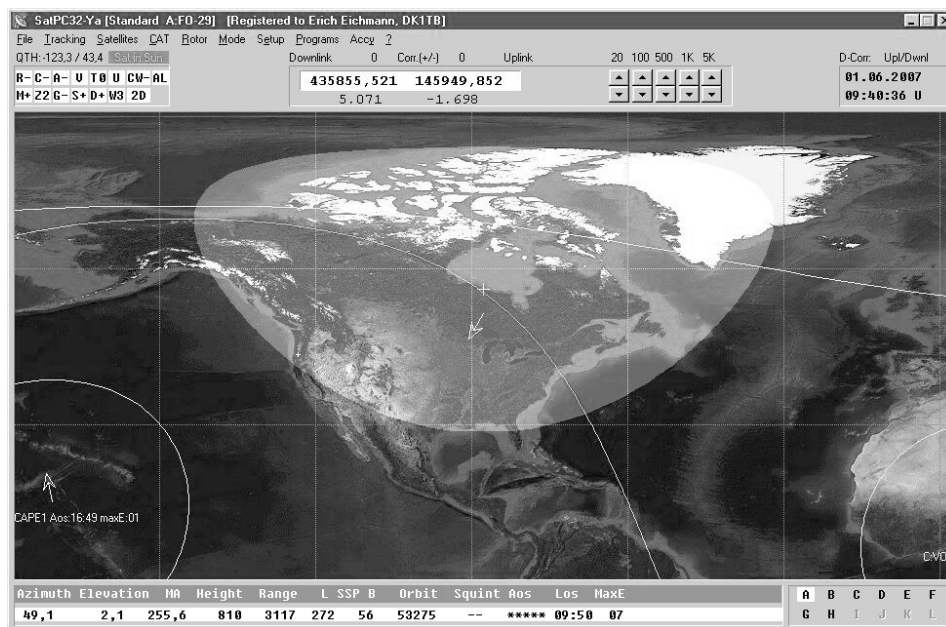
Minimum Donation is \$45 for AMSAT members, \$50 for non-members, on CD-ROM.

A demo version may be downloaded from <http://www.dk1tb.de/indexeng.htm>

A registration password for the demo version may be obtained for a minimum donation of \$40 for members and \$45 for non-members.

Order by calling 1-888-322-6728.

The author DK1TB donated SatPC32 to AMSAT. All proceeds support AMSAT.



On the 23rd of September 2010 at 1314 UTC I was calling CQ via CW on an AO-7 satellite pass in an attempt to have a QSO with N3TE, K9QHO or some other CW satellite operator. I was using my FT-847 in satellite mode and I was transmitting on 70 cm and receiving on 2 m. After calling CQ for about 1 minute KN4SM responded to my call and gave me his grid, i.e., FM16. We had a nice CW QSO for about 5 minutes or so. I had never heard Jerry, KN4SM, on any satellite before, so I thought that I would write him an e-mail and welcome him to the birds. In my e-mail to Jerry I thanked him for the nice cw QSO on AO-7. In Jerry's return e-mail to me he informed me that he has never been on AO-7 and does not have any satellite ham equipment at his QTH. I wrote Jerry back and told him that when I was working him on AO-7 his 2 m downlink signal was drifting through the passband and I was following his signal by adjusting my downlink 2 m VFO. Jerry told me that he was working me via simplex only using his 70 cm radio. Jerry also told me that he was copying my CW signal on 70 cm and not on 2 m.

At first I found this situation perplexing, so I gave it some more thought. I e-mailed Jerry again and gave him my telephone number and asked him to give me a call when he had the time. Jerry called me the next day and we discussed our satellite CW QSO. Jerry told me that his transmitter would only transmit and receive on 70 cm and not on 2 m. After we talked about this for awhile we decided that he was copying my signal on 70 cm simplex and I was copying his signal via AO-7's 2 m signal. Jerry had his antenna pointed in the direction of AO-7 only by coincidence as it made its pass from the north to the south over North America. As I started calling CQ he heard me on his rig via simplex on 70 cm. When Jerry responded to my CQ I heard him on AO-7's 2 m downlink signal. I have never heard of this type of phenomenon happening before on a satellite. Jerry told me that my signal was not moving and that he had stayed on the same frequency during the entire QSO, so we knew that he was indeed copying my 70 cm CW signal via simplex. I copied his moving 2 m signal, so that indeed proved that his signal was coming from AO-7! I wondered if anyone has ever heard of this happening on a satellite before. If so, I would be interested in hearing about it. I don't believe this happens often and it probably won't ever happen again! This was a pure luck incident where Jerry's antenna happened to be pointed at AO-7 when he responded to me as I was calling CQ thus allowing me to hear him on AO-7's 2 m downlink, while at the same time he copied me on 70 cm simplex. We are about 130 miles from each other and Jerry informed me that he was using a large 70 cm Yagi array.

Again, I would like to hear anyone's thoughts about what happened on that particular AO-7 satellite pass. I thought that this occurrence was rare and I wanted to share this rather unique experience with other satellite operators via *The AMSAT Journal*. ☺

Salvaging California Amplifier Downconverters for Satellite Use

John M. Franke, WA4WDL, jmfranke@cox.net

I recently acquired a box full of California Amplifier model 13000 and 130002 MMDS (Multichannel Multipoint Distribution Service) channel downconverters, see Photo A, through a buy-it-now purchase from auction for less than \$1.50 each, including shipping. Surely these treasure troves of microwave components could find use for satellite projects. Since the days of AO-40, many MMDS downconverters like the Drake 2880 [1] and California Amplifier models 31732 [2] and 130016 [3] have been modified for amateur satellite reception. I wanted to look into other possible modifications/applications. Like many downconverters designed for MMDS,

Another interesting non-Amateur Radio S-band reception Web site is: <http://www.svengrahn.pp.se/trackind/UpOnSband/UpOnSband.htm>

I removed the cover from one California Amplifier model 130001 downconverter, see Photo B, and applied power through the IF output connector. Applying +18V, the converter drew 190mA. One project that immediately came to mind was to salvage and remount the local oscillator in its own shielded enclosure. The local oscillator would make a nice marker beacon for the 2.2 – 2.3 GHz satellite telemetry band and could also be used as part of a homebrew converter or transverter for 2.4 GHz. It is easy to

being mounted on a pole and exposed to the weather. Better stability can be expected in the ham shack or if provisions are made to limit temperature variations. There is another way to improve the stability as I will show later in this article. In one example, a California Amplifier model 130002, I was able to tune the local oscillator from 2,277.995 MHz to 2,278.273 MHz using the onboard trimmer capacitor; a total range of 278 kHz for a crystal oscillator shift just over 1 kHz. I have not run a temperature dependency test. That will have to wait until I can finish building my adjustable test oven. I did find the schematic for a California Amplifier downconverter local oscillator on the Internet [7]. The schematic appears to cover at least the models 130001, 130002, and 31732 downconverters or is close enough for my purposes. The 506 Prescaler is similar to a Motorola MC12079.

As shown in Photo C, I fabricated a small plate to mount a BNC connector having a bent wire probe and mounted it on the sidewall of a model 130002 downconverter. The new probe is physically more stable and has a greater coupling coefficient than my crude handheld probe. The signal level was still influenced by cable position and hand waving, but my hands were now free while I was making measurements. Even with the crude coupling, I was measuring 3dBm local oscillator output power. I compared a California Amplifier model 130001 downconverter with a model 130002 downconverter. At first glance, the units are very similar. There are some differences in parts placement around the crystal oscillator stage. In the 130001, the crystal is on the top or component side of the printed circuit board. In the 130002, the crystal is on the bottom side of the printed circuit board. In both cases, the marked crystal frequency is 8.89844 MHz which implies a multiplication factor of 256. The current drain and output power of the two downconverters are similar. The 130001 has a 1994 copyright date and the 130002 printed circuit board has a copyright date of 1991.

I spent some time looking for a suitable enclosure for one of the downconverter local oscillators before I started cutting the circuit board. Whenever I can find a nice shielded box at a hamfest, I latch on to it no matter what is inside. I did find a couple of used



Photo A - California Amplifier MMDS Downconverters.

the RF input is 2,500 – 2,686 MHz and the IF output is 222 – 408 MHz. The local oscillator is a crystal controlled PLL operating at 2,278 MHz. The downconverters have a type N RF input connector and two type F IF output connectors. One F connector serves double duty as the IF output port and the dc input port. The downconverters are powered from a +16 to +24V supply and an internal 78M12A 12V three-terminal voltage regulator. The other F connector provides a test port 20 dB down from the IF port. While this article focuses on the 130001 and 130002 downconverters, the information is general enough for a multitude of California Amplifier MMDS converters.

A good reference Web site for S-band reception is: <http://www.uhf-satcom.com/sband/>. The listing of satellite frequencies reinforces my use of the downconverter local oscillator as a good marker generator.

visually separate the local oscillator section from the rest of the circuitry. The local oscillator, with bandpass filter, occupies a little less than half of the 2-3/8" x 4-7/8" printed circuit board. Bringing a BNC to dual banana adapter probe near the local oscillator output stripline filter, I could easily see the 2,278 MHz signal using my Hewlett-Packard 8441A swept YIG filter spectrum analyzer [4] and I could also read the frequency on my homemade 12.5 GHz frequency counter [5]. The 12V power bus runs along the bottom edge of the circuit board. Cutting circuit traces to remove unused sections from the internal voltage regulator load, the current drain dropped to 79mA.

Judging from figures for similar downconverters [6], the frequency accuracy of the local oscillator is +/-20 kHz and the frequency stability is +/-30-50 kHz. But, the figures are based on the downconverter

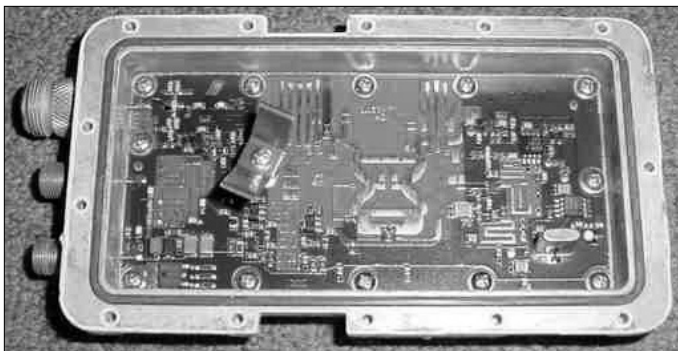


Photo B - Model 13001 Downconverter

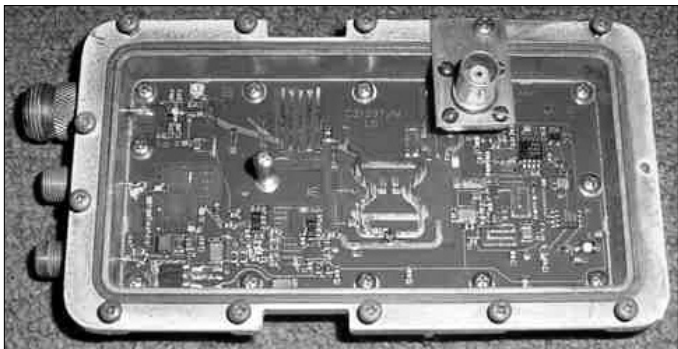


Photo C - Model 130002 Downconverter with Probe

enclosures that would be large enough to contain a PLL oscillator along with a 12V three-terminal voltage regulator. The internal cavity measures 2-7/8" x 3-7/16" and is 1" deep unless the internal 1/8" high mounting pads are used. I used the existing circuit board to size and layout the mounting hole pattern for drilling a 1/16" thick aluminum shelf plate. I cut the local oscillator section from the main printed circuit board of a model 130001 downconverter using a 4" hobby table saw. Adding an RF output cable to the printed circuit board was tricky. I used two U-shaped wires to ground the coax braid and physically restrain the cable. I was able to mount the local oscillator printed circuit board directly to the shelf plate with seven 4-40 screws, lock washers, and hex nuts using the original holes in the circuit board. I drilled a 1/2" diameter hole through the shelf plate under the crystal and a 3/8" diameter hole under the coax connection to prevent shorts and allow the circuit board to sit flush on the shelf. Model 130002 downconverters will require a larger cutout for the crystal under the circuit board. Unused circuit traces were cut and peeled from the circuit board using a razor blade and needle-nose pliers. With the new arrangement, the RF output power measured 10 dBm and the second and third harmonics are at least 20 dB below the fundamental. Hence, the local oscillator can be used to directly drive a double-balanced mixer with a little power to spare. The

local oscillator. The Clarke, predecessor to Nems-Clarke, receiver has a tuning range of 55 to 260 MHz and I have a panadaptor for the 21.4 MHz IF frequency. The receiver IF bandwidth is 300 kHz, which is good for monitoring high speed telemetry. However, I did decide to try an assortment of six crystals from my junk box in the model 130002 test oscillator. The highest frequency crystals, 9.2250 and 9.1750 MHz, produced the same output frequency, 2,342 MHz, which is below the expected frequencies of 2,361.6 MHz and 2,348.8 MHz. So I believe the upper frequency limit of the unmodified VCO is 2,342 MHz. The other test crystals; 9.075, 8.975, 8.875, and 8.625 MHz, all produced the expected output frequencies and power. With no crystal, the output frequency was 2,167.0 MHz. The output power does begin to drop off a couple dB at the frequency limits. Based on the measurements, the absolute VCO range is 2,167 MHz to 2,342 MHz and the output bandpass filter is a little wider. The absolute VCO range implies a crystal range of >8.465 MHz to <9.148 MHz. Many amateurs have reported no problems with using an 8.8125 MHz crystal to get an IF frequency of 145 MH for an input frequency of 2,401 MHz. Information for ordering crystals from ICM is found on another Web site [8].

I removed the onboard crystal, the chip capacitors and trimmer connected to the crystal. I applied an external 0 dBm signal,

enclosure cover plate being on or off had no noticeable effects. Later, I fabricated and installed a three-terminal voltage regulator, 7812, on a short piece of angle aluminum. Photo D shows the local oscillator in the new enclosure without the 7812 and Photo E shows the complete assembly. In future conversions, I will use a #30 wire between the regulator and the oscillator circuit board to reduce the stress on the trace.

I will be using a Clarke 167-J-2 FM receiver for an IF and was not overly concerned about the useable frequency range of the unmodified

terminated with a 47 Ohm load, through a 1000 pF series blocking capacitor to pin 1 (the crystal pin connected to the trimmer capacitor) of the FS4347E oscillator/phase detector integrated circuit. The shield from the reference source is grounded. There is no connection to pin 2. The VCO would lock for drive frequencies from 8.48 MHz to 9.13 MHz. The corresponding output frequencies are 2,171 MHz and 2,337 MHz, a range of +59 MHz to -107 MHz or a total range of 166 MHz. The lock limits of course do fall within the VCO low and high limits. Remember that this was with one specific circuit board, results may vary. But, if you do want increased stability, you can drive the PLL with an external oscillator or synthesizer.

The end result is a compact, stable, low power S-band source for little more than the cost of a crystal. For this effort, I have obviously drawn together the work of others, added some details of my own, and hope others will continue to add as they are able. This is in line with the spirit of Amateur Radio.

References

- [1] Filby, Larry (K1LPS): "Drake 2880 Conversion Summary," <http://www.nitehawk.com/rasmit/mds2880cv.html>
- [2] Moss, Adam (G0ORY): "California Amplifier 31732 Downconverter," <http://www.qsl.net/n9zia/31732/index.html>
- [3] Flowers, Andy (K0SM): "An Easy Way to Receive S-Band Using the Cal-Amp 130016," <http://rvhfg.org/articles/2/7>
- [4] Franke, John M., WA4WDL: "HP 8441A YIG Filter Spectrum Analyzer/Interface," Proceedings of the 12th Annual Southeastern VHF Society Conference, April 25-26, 2008, Orlando, Florida, pp. 143-145.
- [5] Franke, John M., WA4WDL: "12.5 GHz and Counting," Proceedings of the 11th Annual Southeastern VHF Society Conference, April 27-28, 2007, Atlanta, Georgia, pp. 144-147.
- [6] Cal Amp, http://www.calamp.com/home/pro_mmmds.html
- [7] http://www.cqham.ru/image2/cal-amp-dc_big.gif
- [8] <http://www.qsl.net/n9zia/wc0y/> ☎

Photos continue on next page ...

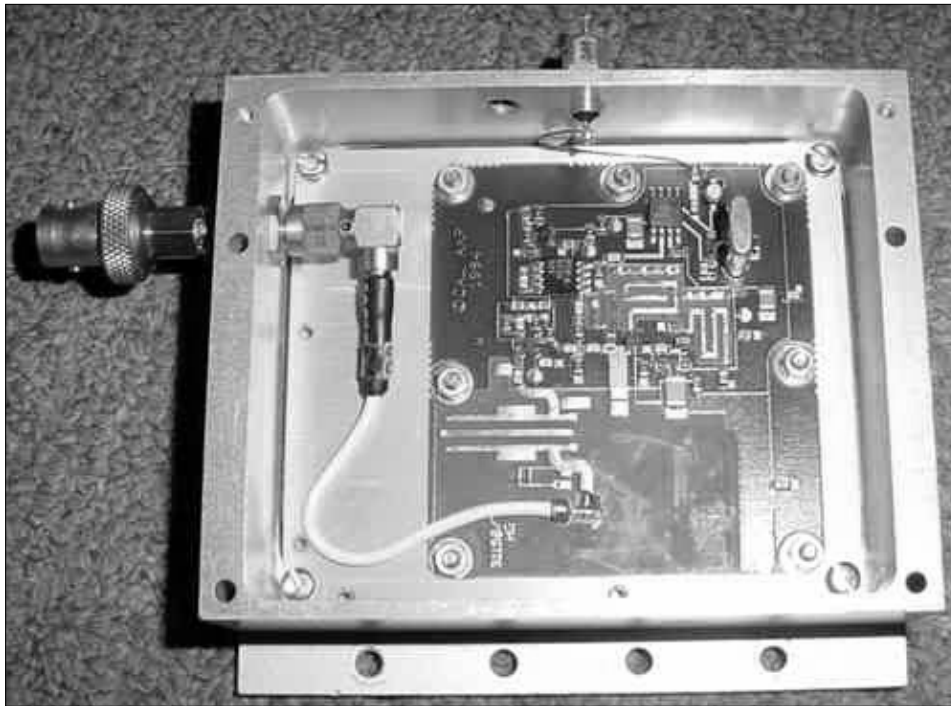


Photo D - Remounted PLL



Photo E - Remounted PLL with Voltage Regulator

AMSAT and ITAR: Lessons Learned

by Barry A. Baines, WD4ASW, wd4asw@amsat.org

President-AMSAT

Introduction

At the 2008 AMSAT Space Symposium, Bill Ress, N6GHZ, presented a paper entitled "ITAR and AMSAT (And other export control rules)" [1] which provided an overview of US regulations pertaining to ITAR (International Traffic and Arms Regulations) administered by the Directorate of Defense Trade Controls (DDTC) of the US Department of State; EAR (Export Administration Regulations) administered by the US Department of Commerce and a discussion of the necessity to determine whether or not it is possible for AMSAT to continue its long tradition of technical exchange and cooperative satellite development work with other AMSAT organizations. Bill's overview was both timely and instructive, because the AMSAT BoD had been struggling to come up with a workable approach that would allow AMSAT to continue to cooperate with AMSAT-DL and AMSAT-UK on Phase 3-E while abiding by the current law. Bill's overview was very instructive for a number of people (including AMSAT BoD members) and highlighted the fact that AMSAT must deal with this critical issue.

This paper provides a recap of the actions taken by AMSAT to deal with the challenges of ITAR since publication of Bill's paper, provides some insight into the strategies developed by AMSAT as events unfolded over the past two years and discusses the overall impact of ITAR on AMSAT and lessons learned from this process.

Background

Congress passed legislation in 1999 to transfer jurisdiction over commercial satellites from the Commerce Department to the Department of State as an ITAR-controlled technology in response to several high profile incidents where space technology had been unlawfully transferred to other countries. Successful prosecution of serious ITAR violations could result in significant monetary fines, loss of export privileges, loss of access to government procurement or government clearances and in cases of willful violations, jail time.

Note that export of space technology means not only the shipment of articles overseas. A deemed export is the release of technical information to foreign nationals and can occur in a number of ways, including e-

mail exchanges, conversations, exchanges of computer files, etc. and can take place within the confines of the United States or anywhere else. Given that AMSAT satellite builders were freely exchanging technical information with foreign nationals in conjunction with the construction of AMSAT-DL's Phase 3-E satellite, in 2006 our volunteers were now wondering whether such exchanges were appropriate under the law. Consequently, AMSAT volunteers stopped their volunteer work on Phase 3-E in response to heightened concerns that perhaps AMSAT volunteers may have been violating ITAR.

In the Fall of 2006, AMSAT President Rick Hambly, W2GPS, had been working with a law firm in the Washington, DC area to see if they could assist us in developing an appropriate management policy on ITAR compliance as well as determine an appropriate strategy for approaching DDTC on developing a Technical Assistance Agreement (TAA) that would pass DDTC scrutiny and be acceptable to other AMSAT organizations as signatories. This process was stymied by the fact that the attorneys that Rick was working with changed law firms in Spring 2007 and that transition eliminated their previous firm's interest in helping AMSAT and prevented them from continuing their work with AMSAT given the priorities of their new firm.

In Fall 2007, Rick then turned to a lawyer who was an AMSAT member and who had expressed interest in dealing with the ITAR situation. This individual spent considerable time getting up to speed on the myriad of details pertaining to this area of law and developed an initial set of recommendations as to how AMSAT might proceed. He drafted a TAA based upon requirements stipulated on the DDTC Web site and this draft was subsequently forwarded to AMSAT-DL and AMSAT-UK for their review/comment. This person became discouraged, however, when it became apparent in early 2008 that neither AMSAT-DL nor AMSAT-UK were interested in signing a Technical Assistance Agreement (TAA) because the language that DDTC requires in a TAA was unacceptable to both AMSAT organizations. In particular, such language places foreign nationals under US Law (e.g., they could be prosecuted by the US government in the event items under

the TAA are disclosed to foreign nationals that are not part of the TAA) and there were concerns that AMSAT organizations being all volunteer, did not have the power to control the behavior of volunteers. Our intrepid volunteer lawyer, realizing that the ITAR issue was even more of a challenge than when he started down this path, decided to bow out of the project.

By September 2008, it was becoming apparent that a new strategy was needed to deal with ITAR. Concerns about ITAR had caused several individuals to withdraw their volunteer support for AMSAT-NA. Morale within AMSAT Engineering was adversely impacted about concerns regarding past activities. Bill's paper in the *2008 Proceedings* was the first overview of ITAR given to the AMSAT membership and marked the start of a new initiative to come to grips with ITAR.

A New Approach

Prior to the AMSAT BOD meeting in October 2008 and while Bill was writing his *Proceedings* paper (I had seen and commented on his draft), I was advised that one of our AMSAT members had been involved with an ITAR issue in relation to his professional dealings. This AMSAT member had retained a lawyer whose specialty is ITAR and export rules because he and the firm in the United Kingdom that he was planning to do business with came to the realization that a Technical Assistance Agreement was needed and perhaps some of his past interactions with foreign nationals in conjunction with his business activities required an attorney to review his past activities. He also alerted some of the AMSAT satellite builders of his ITAR situation. This, and the growing realization of the seriousness of ITAR rules and their possible application to AMSAT, caused them to stop work on Phase 3-E due to concerns that the Phase 3-E project might have ITAR repercussions.

While the process of dealing with ITAR had been somewhat painful, the end result was that this AMSAT member was not fined and he was subsequently able to develop a Technical Assistance Agreement (TAA) that met DDTC requirements that would allow him to have a commercial relationship with a corporation in the United Kingdom. He



was more than willing to share his ITAR experiences with me and provided valuable insight into the path he took in dealing with the problem. He also recommended his lawyer. The key takeaway that I received from him was “AMSAT needs to come clean with The Man”, meaning DDTC.

Up until this point in time, AMSAT was looking forward in terms of dealing with the current regulatory environment. Coming clean meant informing DDTC of prior AMSAT actions that MIGHT have been ITAR violations but which no one really wanted to discuss for fear that there were indeed violations and then having to deal with the implications of such revelations. In essence, AMSAT and our corps of satellite builders were in fear of our past volunteer activities.

At the October 2008 AMSAT BoD meeting following my election as president by the board, I outlined the basics of the conversation that I previously had with the AMSAT member and the board agreed that I should initiate a conversation with the attorney that he had recommended to me, Frank Schuchat of Denver, CO. Frank is a founding member of the law firm Schuchat, Herzog & Brenman, LLC whose specialties include international trade law and federal regulatory matters. His prior experience in Washington, DC as an attorney with the US International Trade Commission (1983-1985) and service as a member of the President's Export Council, Subcommittee on Export Administration (PECSEA), which advises the US Commerce Department's Bureau of Industry and Security on federal export control and defense industrial base programs (1997 - present) are but two examples of Frank's extensive background dealing with international trade. Mr. Schuchat's professional biography may be found here: http://www.shblegal.com/fra_info.php

I called Mr. Schuchat on November 6, 2008 upon my return to New England from my extended trip to Atlanta (the site of the Symposium) and subsequent time spent in the Southeast. During our initial conversation, we covered several areas:

1. Self-disclosure regarding past AMSAT activities involving international relationships;
2. Approaching Department of State (DDTC) about an ITAR exemption for IHU-3 and perhaps other components as well; and

3. The need to look to the future and ensure that AMSAT is properly positioned to deal with ITAR and that our volunteers are aware of governmental requirements. This not only means the appropriate documentation and training, but also recognizing that we have upcoming projects that must be addressed with respect to ITAR, such as SuitSat-2. [2]

It was clear that AMSAT needed assistance with developing an appropriate strategy for dealing with these issues as well as guidance in terms of who within the State Department should be approached as well as how they should be approached. In other words, AMSAT needed a coach on how best to deal with the DDTC to ensure that both AMSAT as a corporation and our volunteers as individuals would benefit from the voluntary self-disclosure process and establish a dialog with DDTC on AMSAT's activities and desire to continue international technical exchanges in such a way as to abide by US Law as well as do so in an way that AMSAT could properly administer our international exchanges under ITAR.

Voluntary Self-Disclosure

A key strategy change was the realization that before AMSAT could have a direct conversation with DDTC about AMSAT's technical exchanges with other AMSAT organizations, AMSAT would first have to disclose to DDTC what our previous experiences were with these organizations. If such interaction may have been violations of ITAR, then it would be best to follow a DDTC standard process known as voluntary self-disclosure. By having AMSAT inform the DDTC of past activities, it would offer a number of benefits:

1. Organizations and individuals who self report themselves regarding potential ITAR violations are much more likely to be given an admonishment rather than suffer legal penalties (e.g., fines/penalties or confinement).
2. AMSAT would provide details on ALL recent activity, such as Phase 3-E, with the aim of better understanding the nature of whatever violations may have occurred as well as ensure that we would not be later accused of not being thorough in the revelation of past activities. However, given that there is a 5-year statute of limitations, AMSAT would not need to disclose details of actions taken with Phase 3-D/AO-40 or AMSAT's involvement as a consultant

to the University of Toronto MOST satellite since those activities took place prior to 2003.

3. Once self-disclosure was made, AMSAT was then free to discuss not only past activities with DDTC, but discuss with DDTC future potential interactions with other AMSAT organizations as well.

Voluntary self-disclosure is a process where the applicant notifies the DDTC of past activities that may have been ITAR violations. The aim is to inform DDTC of activities before DDTC learns of potential violations themselves. The DDTC encourages voluntary self-disclosure as a means to encourage organizations and individuals to come forward with information that might be of value to DDTC, to educate the applicant on whether the disclosed activities were indeed ITAR violations and encourage future compliance with ITAR. Typically, but not always, the voluntary self-disclosure process results in an admonition only with the clear understanding that future violations of ITAR will not be tolerated. Violations that DDTC learns on their own are much more serious since fines or other punishments can easily be the end result.

Voluntary self-disclosure could be done only ONCE and the expectation was that ALL potential violations would be self-reported. In other words, if there was any doubt as to the appropriateness of a past action, AMSAT should report it and let DDTC determine if indeed a violation occurred. If DDTC accepted the report, AMSAT could not self-report again in the future and expect leniency from DDTC.

Over the next month I worked with Mr. Schuchat to ensure that he was thoroughly briefed on all AMSAT activities involving foreign nationals. The focus was on actions taken by US citizens under AMSAT sponsorship in conjunction with the AMSAT-DL Phase 3-E Project and centered on four areas:

1. Can-Do! Bus
2. Internal Housekeeping Unit (IHU-3)
3. Software Defined Transponder (SDX)
4. Phase 3-E Mechanical and Thermal Design

I provided Mr. Schuchat with a variety of documents pertaining to the involvement of AMSAT-NA's volunteers in the Phase 3-E project, including:

1. Copies of scanned articles from *The AMSAT Journal*



2. Copies of scanned papers from *AMSAT Symposium Proceedings*
3. AMSAT News Service (ANS) articles on US participation in Phase 3-E
4. A list of 21 AMSAT volunteers who interacted with foreign nationals on satellite-related projects, including MOST, Phase 3-D and Phase 3-E
5. A list of materials provided by US nationals to foreign nationals in conjunction with Phase 3-E.

From the materials that I provided, in early December Mr. Schuchat came to the conclusion that AMSAT should indeed follow the voluntary self-disclosure process as there was justification for requesting such a process from DDTC. Over the holiday season, he and I worked on the notification letter to be sent to DDTC as well as crafting an e-mail to be sent to the AMSAT volunteers involved with these satellite projects. On January 12, 2009, Mr. Schuchat sent a letter to DDTC signed by him and me notifying DDTC of AMSAT's intent to follow the voluntary self-disclosure process and with the commitment that such the report would be submitted to the DDTC within 60 days. [3] DDTC confirmed receipt of our letter on January 15, 2009. [4]

In an e-mail sent on January 27, 2009 to the AMSAT volunteers potentially impacted by the voluntary self-disclosure process, I noted the following:

My expectation is that the process that we are pursuing under Mr. Schuchat's guidance will benefit AMSAT and our volunteer satellite builders in a number of ways:

- It provides a well-structured approach for dealing with ITAR based upon sound advice/guidance from a recognized authority on ITAR.
- AMSAT will have direct communication with the State Department with appropriate counsel in the room to help guide the conversation and ensure that our concerns are appropriately conveyed.
- We will have an advocate in Mr. Schuchat that understands both the needs of the State Department and AMSAT who can help create an appropriate evaluation of how a small, volunteer organization such as AMSAT should be treated in a regulatory environment that is aimed primarily at corporate structures.
- By submitting a voluntary disclosure, AMSAT can clear the past and lift whatever

fears or concerns that our volunteers and leadership may have about past activities.

- The burden of dealing with the uncertainties pertaining to ITAR compliance will be lifted from the shoulders of our volunteers as well as the AMSAT leadership.

- AMSAT can move forward with a clearer understanding of its role and obligations under ITAR.

- Submission and acceptance of an exemption request will hopefully result in a cleaner process for working with other AMSAT organizations on specific technical issues. [5]

A conference call was held on February 3, 2009 that included AMSAT's legal team, members of the AMSAT Board of Directors, AMSAT senior officers and the 21 US Nationals who were the satellite builders that were previously identified as having interaction with foreign nationals. The purpose of the call was to introduce the legal team (Frank Schuchat and Timothy Pitner) to the AMSAT participants, answer questions concerning the voluntary self-disclosure process, brief participants on next steps and address any questions or concerns that individuals may have about the process. Subsequent to that conference call, interviews were scheduled between Mr. Schuchat's legal team and ten individuals involved with Phase 3-E technical discussions with foreign nationals to gather the facts that would be submitted to the DDTC by the March 15, 2009 deadline. This interview process took nearly a month and included conversations with foreign nationals who were involved with Phase 3-E.

The report itself was submitted to the State Department on March 12, 2009, three days prior to deadline [6]. It included not only information gathered during the interview process, but documents gathered from a variety of sources, such as *The AMSAT Journal*, *AMSAT Proceedings*, *AMSAT News Service* (ANS), AMSAT internal documents, and AMSAT publications. There were a total of 24 exhibits included in the submission:

- 2006 AMSAT Annual Report
- Reprint of a NASA Web page "Ham Radio: What is AMSAT?"
- Copies of various correspondence pertaining to AMSAT's registration with the State Department as a manufacturer and exporter of defense services and hardware/technical data

- A letter from AMSAT-DL President Peter Guezlow to Frank Schuchat regarding support provided by AMSAT-NA for AMSAT-DL's P3-E satellite project

- Copy of Dick Jansson's "Phase III Spacecraft Thermal Design" from the November/December 1984 issue of *Orbit* (Predecessor to *The AMSAT Journal*)

- Copy of "AMSAT IHU-3: Update and Status" published in the 2005 *AMSAT Symposium Proceedings*

- Copy of "Doing More with Fewer Wires in the Harness: A New Approach to Spacecraft On-Board Command and Telemetry Interfacing" by Bdale Garbee, Chuck Green, Lyle Johnson and Stephen Moraco in the November/December 2003 issue of *The AMSAT Journal*

- Copy of "P3E's Software Defined Transponder" by Howard Long that appeared in the 2008 *AMSAT Symposium Proceedings*

- Copy of "Additional P3E News" by Peter Gulzow that appeared in the March/April 2004 issue of *The AMSAT Journal*

- Copy of "P3E-Status" by Peter Gulzow that appeared in the July/August 2004 issue of *The AMSAT Journal*

- Copy of "AMSAT P3E Meeting Report" by Rick Hambly and Bob McGwier that appeared in the January/February 2005 issue of *The AMSAT Journal*

- Copy of "IHU3 Meeting" by Peter Gulzow that appeared in the May/June 2005 issue of *The AMSAT Journal*

- Copy of "Engineering Notebook II" by Bob McGwier that appeared in the July/August 2006 issue of *The AMSAT Journal*

- Copy of Robert Bosch GmbH Web page: "What is CAN?"

- Copy of a paper, "Atmel Microcontrollers for Controller Area Network (CAN)" by Michael Passemard, Industrial Control Business Director of Atmel Corp. (<http://www.atmel.com>)

- Copy of "AMSAT Phase 3 Express: Eight Months After the Kickoff" by Frank Sperber that appeared in the January/February 2004 issue of *The AMSAT Journal*

- Copy of "Software Defined Transponders, Future AMSAT Missions: Phase 3E and Eagle" by Tom Clark and Bob McGwier that was published in the 2006 *Southeast VHF Conference Proceedings*

- Copy of "ITAR and AMSAT (And other



export control rules)” by Bill Ress that was published in the 2008 *AMSAT Symposium Proceedings*

- Copy of “Radio Amateur Satellite Corporation (AMSAT) Balance Sheet as of January 31, 2009”, “Profit and Loss by Job January 2009” and “Profit and Loss Previous Year Comparison, January 2009”

Through the cooperation extended by our satellite builders and the paper trail review that various AMSAT officers performed, we ended up with a thorough and detailed submission to the DDTC that provided detailed information on AMSAT, our involvement with P3-E, an overview of the technology that was in question, an overview of the open source approach to sharing this information, and a review of AMSAT’s history of working on international satellite projects.

DDTC reviewed our submission and the Chief, Enforcement Division replied on March 24, 2009 with a single page letter received on April 3, 2009 by Mr. Schuchat that included the following:

We reviewed your disclosure and have determined that violations under the International Traffic in Arms Regulations (ITAR) did occur. The Department views these violations seriously and strongly cautions AMSAT to take necessary and immediate actions to strengthen its compliance process and procedures.

We note at this time that we are closing this case without taking action to impose a civil penalty. However, we may reopen the case if it is later determined that the circumstances warrant the initiation of administrative proceedings in accordance with Part 128 of the ITAR. We highly recommend your continued oversight and attention to prevent similar incidents from occurring in the future. [7]

This letter gave AMSAT three critical pieces of information:

- a. The level of detail provided was sufficient for DDTC to come to a conclusion and no further information was requested from AMSAT;
- b. AMSAT did indeed violate ITAR; and
- c. Our volunteers and the organization wouldn’t be prosecuted for the actions that were documented in our voluntary self-disclosure.

As I noted in an e-mail sent on April 5, 2009 to those volunteers who were interviewed

for the voluntary self-disclosure, “This is GREAT NEWS for AMSAT. It means that our thorough disclosure process has cleared us of any past wrongs and that AMSAT can now focus on being forward looking rather than continuing to reflect on past actions.” [8]

We also now realized that ITAR violations did indeed occur. However, we were now uncertain as to which of our many documented actions were considered violations or if all of our documented actions were indeed considered violations. For example, was publication of articles in the *The AMSAT Journal* pertaining to US-developed technical items for Phase 3-E considered a violation, or was this considered public domain since these were articles in a publication available to anyone who joined AMSAT? Given the way the DDTC letter was written, we were not certain. Consequently, without further clarification, AMSAT was forced to continue in remain in abeyance concerning all activities associated with Phase 3-E.

This uncertainty continues today, 18 months after the letter was sent to AMSAT. Despite our requests to DDTC for clarification on what steps AMSAT took that were actually ITAR violations, we have not received any further clarification from DDTC.

Next Step: Commodity Jurisdiction Request (“CJ Request”)

Immediately after we received DDTC’s decision, the next phase of our ITAR strategy was initiated, where AMSAT would seek clarification from DDTC of what constitutes public domain and consider whether AMSAT should submit a Commodity Jurisdiction Request to shift technical items pertaining Phase 3-E from ITAR under the Department of State to the Export Administration Regulations (EAR) under the Department of Commerce. Such a shift would lift a significant burden on AMSAT, eliminate the need for a Technical Assistance Agreement with non-US nationals, and simplify the administration associated with technical discussions. While an export license would still be required to physically ship items subject to EAR overseas, the deemed export component of ITAR would be removed from compliance. As noted earlier, a deemed export is the release of technical information to foreign nationals and can occur a number of ways, including e-mail exchanges, conversations, exchanges of computer files, etc. and can take place within the confines

of the United States or anywhere else. Placement of Phase 3-E subsystems under EAR would mean that AMSAT volunteers could hold technical discussions with AMSAT-DL and AMSAT-UK volunteers prior to making such information public domain.

Prior to arranging for the actual meeting with DDTC, AMSAT submitted a series of questions to them to frame the meeting agenda. Those questions were addressed to the head of the space and technology office of the licensing division rather than the enforcement division, which was unwilling to meet with AMSAT. Our intent was to seek guidance on the prospects of a Commodity Jurisdiction Request being favorably considered. Our hope was that DDTC would recognize that some if not all, of our Phase 3-E technical work would be considered not a defense service and thus not be subject to ITAR. The original request for a meeting was made on April 20, 2009. [9] Due to scheduling conflicts, Frank Schuchat and I finally met with State Department at DDTC offices in Washington on July 1, 2009. At that meeting we discussed the Commodity Jurisdiction process and we were encouraged to take the appropriate steps to apply for the Request.

As a result of this meeting, we decided to proceed with the CJ Request approach. To adhere to the CJ Request process, AMSAT submitted four separate CJ Requests, one for each Phase 3-E subsystem (Can-Do! Bus, SDX, IHU-3, thermal/mechanical analysis) involving US citizens. The submissions were made on July 28, 2009 to the DDTC. [10] The submissions included supporting documentation that highlighted information previously published by AMSAT, such as articles in *The AMSAT Journal*. The Can-Do! Bus request, for example, totaled 33 pages including exhibits. Can-Do! is a technology originally developed in Germany for the automotive industry but which AMSAT was applying to a spacecraft. Our CJ requests were based on the fact that “these items, which do not have military applications, are used only for scientific and educational purposes by a non-profit organization which follows open source principles and makes its innovations available in the public domain.”

Once received by DDTC, our requests were reviewed by a number of governmental organizations, including NASA, Department of Commerce and the Department of



Defense. The input that was provided by each consulted government organization to these four requests is unknown to AMSAT and no explanation or supporting documentation was provided by DDTC along with their official response. We received word on October 16, 2009 (a week after the 2009 Space Symposium) that all four CJ Requests were denied by the DDTC. [11] This clearly was disappointing news and meant that all four areas of Phase 3-E development remained subject to ITAR. Further, since no explanation was given for these decisions, no recognition was given to our publications, open source approach to development, and lack of commercial gain for the items involved.

Just as was the case with our voluntary self-disclosure, the DDTC provided no details for the decisions that were rendered which would help to guide future conduct. Just as we had not received specific information on which of the actions taken by AMSAT and identified in our voluntary self-disclosure back in January were considered ITAR violations, we were once again dealing with a governmental response that provided no details as to why our four commodity jurisdiction requests were denied.

Consequently, AMSAT now faced the following situation:

- All of the subsystems development work done by US citizens in support of Phase 3-E is subject to ITAR;
- AMSAT's actions identified under our voluntary self-disclosure were deemed to be violations of ITAR, though details on specific actions that were deemed violations are not known;
- Continued efforts to maintain working relationships with AMSAT-DL and AMSAT-UK would require ITAR-based Technical Assistance Agreements; and
- Our position that the technical work being done was in the public domain following open source principles was not accepted by the DDTC.

Furthermore, uncertainty regarding the applicability of public domain remained. Under ITAR, technical material considered to be in the public domain is not subject to ITAR. The question is, "How does technical information become public domain?"

Request for Advisory Opinion

Since the DDTC Office of Policy did not accept the positions taken in our four CJ

Requests, further clarification was needed to better understand how AMSAT should consider use of public domain. During the month of November I worked with Mr. Schuchat to craft an Advisory Opinion request to DDTC seeking clarification on what constitutes public domain. On December 4, 2009, AMSAT went back to the DDTC seeking clarification on what constitutes public domain. As noted in our Request for Advisory Opinion (AO), given that our systems were subject to ITAR and that the Technical Assistance Agreement (TAA) approach had serious problems given that foreign AMSAT organizations were very reluctant to sign such documents, we were seeking guidance from DDTC concerning "how it (AMSAT) may continue its cooperative activities with AMSAT-DL and other foreign AMSAT organizations while still assuring compliance with ITAR."

In our submission, AMSAT requested guidance in two areas:

1. Technical data and public domain issues.

AMSAT has consistently maintained a policy of treating any technical information generated through its volunteer projects as open source and publicly available. Accordingly, AMSAT regularly disseminates information on technical activities in its journals and published proceedings, at presentations at conferences (where some foreign persons usually are in attendance) and through various means of electronic distribution. AMSAT members also organize their own personal communications on technical subjects among fellow members. It is an established and accepted tradition that technical information generated for AMSAT projects is not restricted or licensed for a proprietary purpose.

We request advice on the following specific points:

- Can AMSAT presume that AMSAT technical information (disseminated by the methods described above) is largely or exclusively in the public domain?
- Is information considered to be in the public domain if it is distributed electronically to a wide and unrestricted audience?
- How would AMSAT identify exceptions, if any, to the public domain rule?

2. Licensing of Defense Services

AMSAT appreciates that the provision of defense services to AMSAT-DL or other

foreign Amateur Radio societies may require a license, independent of whether the related technical information is in the public domain or is considered technical data.

- Is the DSP-5, Application/License for Permanent Export of Unclassified Defense Articles and Related Unclassified Technical Data, an appropriate mechanism to obtain authorization for the export by AMSAT of any specific defense services and related defense technical data (i.e. any technical information that is not in the public domain)? [12]

The Directorate of Defense Trade Controls (DDTC) responded to our advisory opinion request on March 1, 2010. Specifically, as Mr. Timothy Pitner summarized State's response, AMSAT was advised:

- (1) Information distributed only via the Internet or other electronic means is not in the public domain within the meaning of ITAR; and
- (2) While the regulatory framework favors the provision of defense services and technical data to be accomplished under a TAA or manufacturing license agreement, in exceptional circumstances typically where the scope and level of technology release is low, the State Department may issue a DSP-5 license authorizing the export of defense services.

The response from DDTC regarding public domain has several implications:

- a. If electronic means is not an acceptable method of making information public domain, then only published material is considered public domain. Consequently, free exchange of information electronically could only occur after publication that prevents free exchange during development of technical information. For example, two AMSAT members who are US nationals could publish an article in *The AMSAT Journal* and make it public domain, but they could not collaborate with a foreign national in the development of that article. It also likely means that publication could only take place in the United States since foreign nationals could not see the material prior to actual publication unless there was a TAA in place.
- b. "The only exception to the public domain rule would be if the export met

article continues on page 26 ...





LVB Tracker Box

- Reasonably priced and all profits go to AMSAT
- USB or serial interface
- Ethernet interface capable
- Open software
- Open architecture
- Built-in rotor interface cable with DIN connector
- Power supplied via the rotor controller cable
- Bi-directional interface allows the unit to read the rotor position
- LCD position readout
- Front panel manual control
- Self-programmable, allows for easy software upgrades
- Supported by the major tracking programs
- Uses GS-232A or Easycomm I/II protocols

Contact Martha at the AMSAT office 301-589-6062 to order.

The complete units will be built in groups, so get your orders in early. Units will be shipped as they become available.

Minimum donations requested for various configurations:

- 1) Bare board - \$20 + S&H - no parts kits available
- 2) Populated board, serial interface - \$100 + S&H - no kit with USB unit, rotor cable and LCD available, we do have a parts list with recommended part numbers and sources.
- 3) Custom Ten-Tec Enclosure powder coat, silk-screened, drilled/punched - \$50 + S&H
- 4) Complete unit - board, USB output, rotor cable, LCD, enclosure - \$200 + S&H **our most popular

Documentation for the LVB Tracker can be found at: <http://www.LVBTracker.com>

Boards and complete units may be ordered from the AMSAT office at 301-589-6062 or from martha@amsat.org

THE R.F. CONNECTION

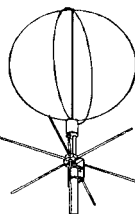
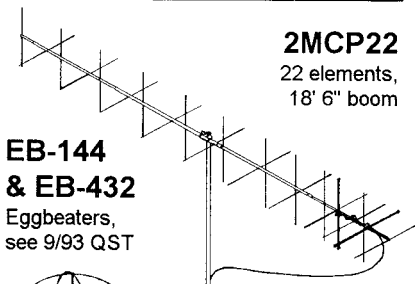
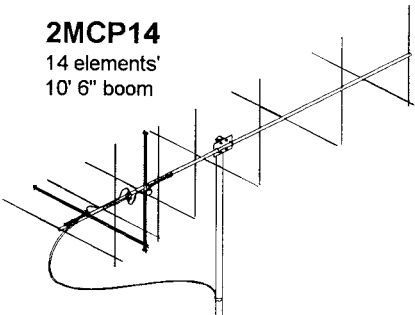
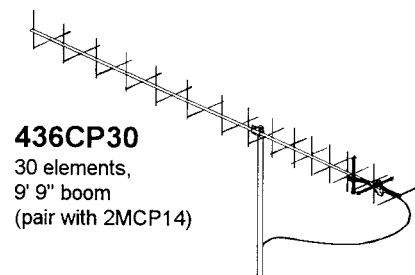
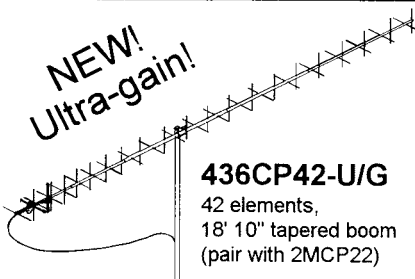
*"Specialist in
R.F. Connectors and Coax"*
<http://www.therfc.com>

301/840-5477
Fax 301/869-3680
E mail: rfc@therfc.com

Order Line 800/783-2666
Suite 11, 213 N. Frederick Ave.
Gaithersburg, MD 20877

M² YOUR SATELLITE ANTENNA SOURCE

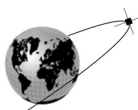
NEW!
Ultra-gain!



- Stacking frames
- AZ & EL positioners
- Fiberglass crossbooms
- Power Dividers
- Phasing harnesses

M² 4402 N. Selland
Fresno, CA 93722
(559) 432-8873 FAX: 432-3059





Apogee View - continued from page 3 ...

ARISS program. We also hope that Amateur Radio clubs and individual Amateur Radio operators are interested in working with their local schools to bring ARISSat-1 into the classroom. We're working with our AMSAT Journal and ANS team to develop materials on ARISSat-1/ RadioSkaf-V as well as working with other media outlets.

As noted previously, it is the educational outreach capability of ARISSat-1/RadioSkaf-V that has provided AMSAT and ARISS the opportunity to place an Amateur Radio payload into low earth orbit. For a number of reasons, AMSAT recommitted itself to this project after the original SuitSat concept had to be dropped. Some reasons are:

- Free launch of Amateur Radio capabilities in exchange for supporting student experiments being flown and supported
- A platform for technology development (such as SDX)
- Potential for recurring flight opportunities (which is one of the reasons why we built four payloads at one time)
- Fulfill commitments made to RSC-Energia/maintain AMSAT credibility with both RSC-Energia and NASA
- A program that would help to rebuild the AMSAT engineering team

Fund Raising

The amount of sweat equity invested in ARISSat-1/RadioSkaf-V by AMSAT volunteers is truly impressive. AMSAT has developed a very capable payload that is the result of the hard work and dedication of the ARISSat-1 team. Many of the individuals involved with ARISSat-1 development have not been involved with prior AMSAT engineering projects, so the experience they've had in completing this project helps to provide a foundation for future satellites. The development of our engineering team continues.

Along with the investment in time, energy and intellect, AMSAT has also invested a significant amount of funds in this project as well. While ARISSat-1 will enjoy a free launch, the satellite is not free:

- Development costs
- The transition from a spacesuit to a spaceframe
- Hardware costs

- Testing (vibration, thermal/vac)
- Shipping two payloads to Houston
- Travel (including sending an AMSAT representative to Russia for final integration)

Based upon expenditures to date plus anticipated expenses later this year, we will have invested about \$180,000 in ARISSat-1 over the past three years. In return for making the investments necessary to finance the transition from SuitSat to ARISSat, we will end up with four flight units (plus the prototype). Along with creating a technology demonstrator that will be the first use of a software defined transponder by an Amateur Radio in low earth orbit, we will also benefit from placing other technology into space, such as the microprocessor controlled power system (Power Supply Unit and Max Power Point Trackers) and internal housekeeping unit (IHU). We will also be prepared to take advantage of future ARISSat-type missions if/when they become available.

I am very proud of AMSAT's completing ARISSat-1/RadioSkaf-V and look forward to seeing it deployed from the International Space Station, currently expected to take place in late February during EVA-28. Given the significant engineering achievement of reconfiguring the project from a space suit to a space frame and completing the project in less than 18 months once that transition became necessary, AMSAT has accomplished a very significant technical challenge on very short notice. Our focus on getting the job done has meant that we haven't advertised the financial impact of this project. Rather, we focused on demonstrating AMSAT's technical ability to complete this project. Frankly, given the fact that AMSAT had not completed a satellite project since 2004, we were not anxious to ask for financial support given our recent track record. Further, given that ARISSat-1 did indeed take longer than originally envisioned and has made a significant impact on our ability to start on Project Fox, it didn't make sense to ask for funding support for ARISSat-1 until after we demonstrated that the project could be completed by AMSAT.

Now is the time to ask for membership support of AMSAT's engineering projects. The success this year in completing ARISSat-1 creates the foundation for Project Fox. In essence, we're looking for support for two projects, one completed and one now starting development. For AMSAT to fund

both projects, we are depending upon the financial support of our membership and others to help provide the financial support for AMSAT.

In November our members will receive a fund raising letter which will outline in more detail the future of AMSAT engineering and the financial impacts of our projects on the organization. I ask for your consideration of what AMSAT is accomplishing and our significant efforts to date to keep Amateur Radio in space. Your personal support is vital to AMSAT's ability to keep moving forward with spacecraft that meet the future needs of Amateur Radio.

2010 AMSAT Symposium

The 2010 AMSAT Symposium in Elk Grove, IL was a rousing success. We enjoyed a significant number of papers that were presented. ARISSat-1 was a significant subject of discussion, but there were other materials offered as well. Students, local Amateur Radio operators, and others also attended the Symposium. The AMSAT Symposium Committee, led by Kermit Carlson, W9XA, did a masterful job of organizing and managing the Symposium with an outstanding audiovisual system, excited and helpful volunteers and a well-organized event. The Sunday afternoon tour of Fermi Lab was well attended and enjoyed by those who took advantage of the opportunity. Many thanks to those who made the trip to Elk Grove Village, IL to join us at Symposium and the Annual Meeting that took place on Saturday afternoon.

73,

Barry A. Baines, WD4ASW
President



Edited on Halloween!



AMSAT[®] President's Club! Join Now!

Contribute to **AMSAT[®]** directly through easy, automatic charges to your credit card.
Donations may be USA tax deductible. (Check with your tax advisor.)

Titanium Donors contribute at least US \$400 per month.

Every **Titanium Donor** receives gifts of:

☐ \$400 / month

- ✓ Everything at the Platinum Donor Level, PLUS:
- ✓ A very special, *hand crafted*, AMSAT President's Club Donor's pin.

☐ \$4800 one time

Platinum Donors contribute at least US \$200 per month.

Every **Platinum Donor** receives gifts of:

☐ \$200 / month

- ✓ Everything at the Gold Donor Level, PLUS:
- ✓ A very special, *hand crafted*, AMSAT President's Club Donor's pin.

☐ \$2400 one time

Gold Donors contribute at least US \$100 per month.

Every **Gold Donor** receives gifts of:

☐ \$100 / month

- ✓ Everything at the Silver Donor Level, PLUS:
- ✓ A personal invitation to the AMSAT Dayton dinner (free).

☐ \$1200 one time

Silver Donors contribute at least US \$50 per month.

Every **Silver Donor** receives gifts of:

☐ \$50 / month

- ✓ Everything at the Bronze Donor Level, PLUS:
- ✓ A personal invitation to a reception with the AMSAT Directors, Officers and project designers and builders (free).
- ✓ Annual endorsement sticker after each year of donation.

☐ \$600 one time

Bronze Donors contribute at least US \$25 per month.

Every **Bronze Donor** receives gifts of:

☐ \$25 / month

- ✓ A unique "AMSAT President's Club" certificate.
- ✓ A specially designed AMSAT President's Club Donor pin.

☐ \$300 one time

Core Donors contribute at least US \$10 per month.

Every **Core Donor** receives gifts of:

☐ \$10 / month

- ✓ A specially designed AMSAT President's Club Donor pin.

☐ \$120 one time

Choose where your contribution should go:

☐ AO-Echo ☐ AO-Eagle ☐ ARISS ☐ Future Projects ☐ General Fund

☐ RENEW my
President's Club
AUTOMATICALLY
every year!

☐ I prefer to make my donation in one yearly payment of \$ _____.

(Credit card only, please.)

THANK YOU!



Remember the Alamo – A Special Event Opportunity

Allen F. Mattis, N5AFV, n5afv@amsat.org

Frank Tolbert, a noted Texas historian and journalist, once said “Every Texan has two homes: his own and San Antonio.” I visit San Antonio every couple of years and a recent industry conference provided the opportunity for me to again enjoy my other home. I always visit the Alamo when I am in San Antonio, and this trip was no exception. My hotel was just a short walk from the Alamo.

The Alamo (<http://www.thealamo.org/>) has been managed by the Daughters of the Republic of Texas since 1905 and is a must see for all who come to San Antonio. The museums at the Alamo contain exhibits on the Texas revolution and Texas history. Many American grade school students learn about James Bowie, David Crockett, William B. Travis and the other defenders of the Alamo who died on March 6, 1836 when the army of General Antonio López de Santa Anna stormed the Alamo.

A number of years ago on a trip to San Antonio it occurred to me that it would be possible to work satellite passes from the Alamo using my Icom W32A HT and a Premier (Pryme) AL800 telescoping antenna. This portable station is very compact and does not draw attention (Mattis, 2005). I almost always take this equipment

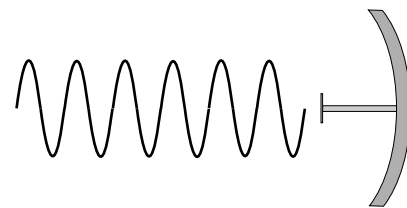
with me when I travel and have made over 9000 satellite contacts with it. I am certain that the Texas Department of Public Safety officers who guard the Alamo twenty-four hours a day would not let me operate at that location if I used an Arrow antenna, but the HT with an AL800 does not draw as much attention.

I have operated satellite passes from the Alamo four different times in the past nine years. I usually operate from the park located approximately 150 feet from the Alamo, however, on one of my earlier operations I made two contacts while standing 40 feet from the front door of the Alamo. My most recent operation from the Alamo took place on October 11-12, 2010 when I worked two passes of AO-27 and one pass of SO-50 making a total of 15 contacts. I have a special QSL card with a picture of the Alamo for those who work me there and send me their QSL card.

References

Mattis, A. F., 2005, “HT and AL800 Antenna – An Excellent Portable Satellite Station”, *The AMSAT Journal*, March/April (Volume 28, No. 2), pp. 21-23

Mattis, A. F., 2005, “Postscript to HT and AL800 Antenna – An Excellent Portable Satellite Station”, *The AMSAT Journal*, May/June (Volume 28, No. 3), p. 17



On Oct.21, AMSAT's favorite “cover girl” Marie Marr stopped by the office in Silver Spring. For those who don't remember Marie, she built the wiring harness for the AMSAT-OSCAR 6 thru 10 satellites built in the Washington DC area. Marie, who now lives in Oklahoma, was in town visiting her daughter and celebrating her 89th birthday. On hand for the event were old friends Martha, W3PK, W4PUJ and K3IO.

73, Tom, K3IO



The Alamo in San Antonio, Texas (EL09sk). Note the DPS officer present at lower left.

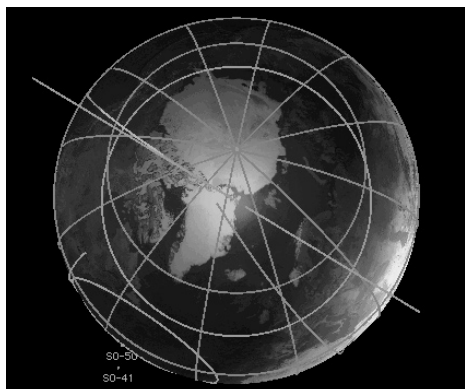
The AMSAT Store (see www.amsat.org) is back online! Here is a new AMSAT product. A handsome and functional AMSAT 10' locking carpenter's tape with both inch and metric scales.

Minimum donation: \$5



MacDopplerPRO X

The premier Satellite tracking and station automation application for the Macintosh - OS 9 & OS X



MacDoppler for Cocoa gives you a seat right in the heart of the Operations & Command Centre for every satellite in orbit, providing any level of station automation you need from assisted Doppler Tuning and Antenna Pointing right on up to a fully automated Satellite Gateway !

It will calculate the position and relative velocity of the satellites you are tracking and automatically adjust the Doppler shift on both transmit and receive as well as pointing your antennas with predictive dead spot crossing so that a pass is never interrupted.

A Universal Binary that runs native on Intel and PPC Macs and provides separate panels for the map (2D or 3D), the radio and rotor controls, a sorted table of upcoming satellite passes and a Horizon panel that graphs upcoming passes as a function of elevation over time.

Now available from AMSAT at a special member discount donation!

martha@amsat.org
850 Sligo Ave.,
Silver Spring MD,
20910-4703 USA.

(301) 589-6062, (301) 608-3410 (Fax)

Dog Park Software Ltd.
www.dogparksoftware.com

Do you still use manual tuning to remove Doppler changes? Why not automate?

Uni-Trac 2000 will automatically tune your Receiver (and Transmitter) to compensate Doppler frequency changes. Uni-Trac will also STEER your Antenna !

Uni-Trac 2000, including Interface Cable \$280.00
FOB Concord, Mass. 01742, USA.



Spectrum International, Inc.,
P.O. Box 1084,
Concord, Mass. 01742, USA.
Tel: (978) 263-2145
Fax: (978) 263-7008

Help Wanted

AMSAT needs qualified volunteers for a number of positions!

If you want to be a part of the solution in making AMSAT operational and work toward designing, building and finding a launch, WE NEED YOU!

No pay for 5+ hours per week, but a great deal of satisfaction in knowing you are helping make something happen.

We need people with these skills:

- Marketing
- Sales
- Software engineering
- Hardware engineering
- PC based software design
- Web design and maintenance
- Project management
- Documentation
- Hardware testing
- Software testing
- Hardware prototyping
- Specific area Web site information maintenance
- Video recording, digital conversion and editing
- Write technical or instructional material
- Educational activities
- Promoting AMSAT as an Area Coordinator



and any other area you think you think you can make a difference.

We often have people volunteer, but many don't deliver on their promises. So, pick an area that you think needs improvement and explain what you will do to make it better. Then do something to show that you can follow through.

Send your suggestions, actions plans and a description of why you are capable of doing this task to Gould Smith, WA4SXM, wa4sxm@amsat.org



one of the applicable ITAR exceptions or did not fall under the definition of technical data.” [13]

The potential application for a DSP-5 license is one that AMSAT continues to consider, but no action has been taken. After nearly two years of dealing with the DDTC, we have learned that as a non-profit organization connecting widely dispersed volunteers with strong engineering and other skills who exchange ideas and collaborate on projects as a hobby, we are unlike any other exporter in DDTCs world and the only response they seem to have available is to deny our request for guidance. Given the significant AMSAT resources, including legal fees, volunteer time (senior officer, BoD and others) expended to date on ITAR, we realize that further investment in this process may not result in a tangible benefit, as it is much too easy for DDTC to summarily deny our request, even if its representatives acknowledge that such a path is reasonable.

A decision by AMSAT to pursue a DSP-5 license to provide a means for continued AMSAT involvement with Phase 3-E would be contingent upon several considerations:

- The cost of pursuing this approach. The legal fees would be based upon the number of man-hours required to develop the application and manage the process. At this point, we estimate fees in the range of about \$800-\$2,000.00.

- What are the expected benefits? Given that AMSAT volunteers withdrew from Phase 3-E development over four years ago, the technology has evolved and development work has been taken over by Europeans. For example, the FPGA originally used for the IHU-3 is no longer in production. AMSAT-DL is looking toward a different design. Given this evolutionary process, how critical is it for AMSAT volunteers who are US citizens to share technical information (schematics, PCB layouts, etc.) for what may be an obsolete design?

- Are AMSAT volunteers willing to help with Phase 3-E? Given the hard lessons learned about ITAR compliance, it is easy to understand why US nationals would prefer to be no longer involved with international projects.

- Would individuals (both US and foreign nationals) be willing to sign the DSP-5 application and subsequent end-user certificates? Since neither AMSAT nor

AMSAT-DL satellite builders are employees, volunteers would be responsible for their own actions and would be required to sign the DSP-5 documents as individuals. [14]

- What are the prospects for Phase 3-E? AMSAT-DL continues to look for funding to pay for final development and the launch costs for this satellite. At this point in time, there are no guarantees that such funding will be secured or that the satellite will be completed.

2010 AMSAT-UK Colloquium

I attended the AMSAT-UK Colloquium held in Surrey during the last weekend in July. I gave a presentation on AMSAT activities, including the extensive effort we had undertaken in response to ITAR-related concerns. My presentation was an eye opener for many in attendance, for some were unaware of the severe limitations that ITAR places on US citizens regarding discussions and technical exchanges that fall under this law.

I reviewed the steps that had been taken since October 2008, including the implications created by our voluntary self-disclosure process, and made it clear that while AMSAT considers international cooperation on satellite projects to be a cornerstone of our organization, we could not assume the risk of violating ITAR. Given that neither ITAR nor the government bureaucracy was designed to easily deal with the idiosyncrasies of an all-volunteer not-for-profit organization that built small communications satellites, AMSAT was having significant issues in convincing Washington of the appropriateness of volunteer satellite builders openly sharing information that is considered subject to ITAR with like-minded satellite enthusiasts in Europe.

As AMSAT-UK videotaped all of the Colloquium presentations, my presentation may be found in the film archive at: <http://www.batc.tv/>.

Lessons Learned from the ITAR Process

The past two years have been very revealing, as AMSAT has dealt head on with coming to grips with ITAR. While this was certainly a very necessary process, particularly with regard to resolving past activities and clearing the air for both our volunteers and the organization itself regarding AMSAT's involvement with Phase 3-E, our experience has also been a huge investment in AMSAT management talent and focus as well as a

large financial outlay. AMSAT's legal fees related to ITAR have exceeded \$50,000.00 since October 2008. Here are my lessons learned from this experience (not in any particular order):

1. You may think that AMSAT is primarily a scientific and educational organization, or even view AMSAT as an Amateur Radio organization, but the US Government defines AMSAT as a Munitions Supplier. That is because we build communications satellites, a category that is included in the US Munitions List. No exceptions are given to organizations based upon size of the organization, size of the satellite being built (CubeSats qualify under the munitions list), type of satellite, or whether the person(s) involved are volunteer or paid.

This blanket definition has a financial impact on AMSAT as we pay a \$2,500 licensing fee each year to be registered with DDTC. This license allows AMSAT to apply for export license for such things as sending antennas to ESA for placement on the Columbus Module on the ISS (which occurred in 2009 as we were dealing with ITAR voluntary self-disclosure). AMSAT was prepared to submit an export license for Radioskaf-V (ARISat-1) until NASA agreed to do the export licensing paperwork and ship the satellite to RSC-Energia rather than have AMSAT ship the satellite to Russia.

2. ITAR is for real. AMSAT has cleared itself with DDTC with voluntary self-disclosure, but we get only one get out of jail free card. Any future violations will cause real hardship for both the organization and the volunteer(s) who disobey the law.
3. ITAR has unintended consequences. Congress forced communications satellites into ITAR in 1999 without regard to the impact on not-for-profit, all volunteer organizations. The same rules apply to AMSAT as any large or small commercial entity in the communications satellite sector. Even the for-profit sector has problems with the current situation and industry associations have stepped up their efforts to persuade the government that communications satellites should be controlled by the Commerce Department because of the negative effect ITAR has



on US exports in this area.

4. It is easier for a government organization to say no than to say yes. The decision not to allow Phase 3-E subsystems to shift from ITAR to EAR without giving us any supporting documentation or rationale reflects the black-box-like regulatory process and the lack of a framework to address the needs of smaller scientific and educational organizations. DDTC processes as many as 80,000 license applications annually and is stretched for resources as it is. But our preference is DDTC should exercise some discretion to differentiate between organizations and projects under varying circumstances which do not implicate US national security and foreign policy interests.
5. It is very expensive to abide by the regulatory process. AMSAT has invested over \$50,000 in legal fees dealing with ITAR since 2008. We have received excellent legal advice for those funds and I have no qualms defending the decisions made that resulted in these expenditures. But there is a finite limit as to what AMSAT can afford to spend on trying to maintain international working relationships that had been in existence for over 20 years. The cost of ITAR also includes the loss of advancing the state of the technical art that is achieved through international cooperation and is the underlying basis for encouraging Amateur Radio in the first place.
6. Government activities under ITAR are designed to block information exchange, not encourage it. There is no incentive for a government employee to approve an exemption to ITAR when there exists the minutest chance that such a decision will be criticized at a later date.
7. A corollary is that it is currently difficult for government to differentiate between threat levels and to focus on protecting information that is more critical than others. Even if a rogue nation secured the IHU-3 design, clearly the value of this technology is significantly less critical than the control hardware/software of military hardware. Yet, DDTC has determined that even the IHU-3 requires protection under ITAR and that it cannot be transferred to EAR. DDTC is not willing to differentiate between the technical developments

done by volunteers in someone's garage on the cheap and a multimillion dollar commercial or government contract.

8. Future AMSAT satellite projects will either be US only (such as Project Fox) or fall under someone else's Technical Assistance Agreement, such as the agreement between NASA and RSC-Energia that is being applied to Radioskaf-V (ARISSat-1). Given that AMSAT's ability to work with Russian nationals is contingent upon this TAA, all communications between AMSAT and Russian nationals includes NASA personnel to ensure that the TAA is strictly adhered.
9. The impact of ITAR is worldwide within Amateur Radio. Along with the direct impact on AMSAT-DL's Phase 3-E project, ITAR also prevents US nationals with assisting other satellite programs as well, such as AMSAT-ZL's KiwiSat without first gaining the appropriate government approvals. The cost of supporting that project is not only the legal fees associated with developing a TAA (to be paid by someone) but the significant legal obligation that foreign nationals (who are also volunteers) must be willing to subject themselves to US law.
10. Government agencies don't know how to deal with unique groups such as AMSAT. While AMSAT prides itself with our distinguished history of literally building satellites in our garages, government sees AMSAT, an all-volunteer not-for-profit organization as a threat. Commercial entities have paid employees and a hierarchical structure. Failure to abide by company rules and government regulations results in firing and loss of income for the offending employee. There are strong organizational incentives in a paid environment for compliance. Likewise, corporations are liable for the actions of their employees.

Volunteer organizations don't hire or fire. Volunteers decide what they will or won't do as volunteers. The only control that a volunteer organization has over their volunteers is moral persuasion and withholding reimbursement funds for expenses (such as paying for parts or travel). Such lack of control is seen as a significant downside by regulators in dealing with enforcement since

volunteers can act independently and organizations don't have direct control over volunteers.

Consequently, regulators may be more likely to hold individuals accountable, whereas in industry the organization is targeted for any fines and penalties. This direct involvement can have a chilling effect on volunteer participation in projects involving ITAR compliance since the individual may need to take steps to ensure that they are fully aware of the commitments being made as an individual and may even seek their own legal counsel prior to signing such documents.

11. Compliance with ITAR is both expensive and time consuming for AMSAT. The administrative cost of ITAR compliance even when there are no legal issues can be very costly. Failure to have the proper paperwork can result in legal action by the DDTC even if the spirit of ITAR is fully complied. For example, within the scope of a TAA, logs must be kept of all interactions with foreign nationals involving subject matter applicable under ITAR as well as documentation of all exchanges. This includes phone calls, e-mail exchanges, visits to facilities, etc. There must also be a compliance program in place designed to ensure that all affected personnel are trained and familiarized with proper procedures under ITAR. If AMSAT were to have a TAA with another organization, part of the cost of administration of that TAA would be compliance administration. [15]

An interesting legal question is whether an all-volunteer organization such as AMSAT can indeed be held accountable for ITAR compliance if the legal documents (TAA, DSP-5, etc.) are to be signed by individuals and not by AMSAT. Again, the legal structure behind ITAR doesn't necessarily fit well with an all-volunteer organization. Would individuals serving as AMSAT volunteers be held accountable for their own compliance training or would AMSAT?

Even if there isn't a formal relationship with other AMSAT organizations, satellite builders must be mindful that there are severe limitations with

article continues on page 29 ...



2010 Space Symposium and AMSAT-NA Annual Meeting

Held October 8-9-10, 2010 at Chicago/Elk Grove Illinois

Contents include articles on AMSAT's Satellites, Opportunities in Education, Satellite and Earth Station Technology and more. For example:

- Software Technology on ARISSat-1
by Tony Monteiro, AA2TX
- AMSAT-Fox Preview
by Tony Monteiro, AA2TX
- AMSAT NextGen CubeSat Proposal - Evolutionary Leveraging of Assets and Opportunities
by NextGen Satellite Team - Alex Harvilchuck, N3NP
- Ham TV Experiment On-board ISS
by F Azzarello, IW8QKU, E. D'Andria, IOELE, T. Giagnacovo, IZ0LTG, and P. Tognolatti IOKPT
- BPSK-1000 Format for ARISSat-1
by Phil Karn, KA9Q
- How to Work the FM Satellites With Your Handheld Radio
Clint Bradford, K6LCS

Now Available!

To Order: Proceedings - 2010

(8½" x 11", 272 pages)

See the AMSAT Store: www.amsat.org or

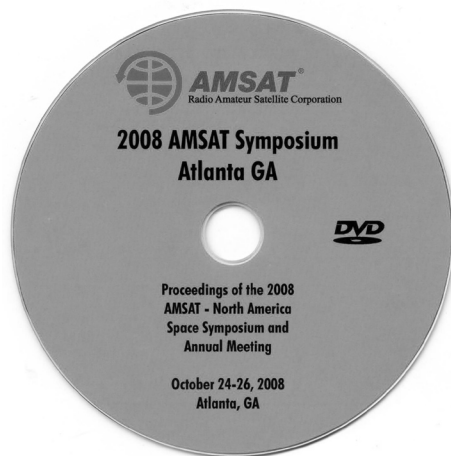
Write, telephone or FAX:

AMSAT-NA
850 Sligo Ave. #600
Silver Spring, MD 20910, USA

Tel: 301-589-6062
Fax: 301-608-3410

Minimum Donation:

\$25 anywhere + postage.
For details click on "AMSAT Store" at www.amsat.org. VISA, MasterCard or Discover charges accepted.



2008 Proceedings DVD's also available. Contact the AMSAT Office.

A new DVD for the 2008 Symposium is available. It has the presentations, audio files and papers.
Dan Schultz's Banquet Talk on The Hubble Space Telescope Repair Mission - slides and audio
Phil Hartman's Introduction to DSP Workshop - slides and audio plus
2004 Symposium papers
2005 Symposium papers
2007 Symposium papers

release of information subject to ITAR prior to that material becoming public domain.

12. While there is continuing talk in Washington about revising ITAR to make US companies more competitive in the international marketplace, there are no guarantees that such changes will relieve AMSAT or universities of the burdens of ITAR. We are below everyone's radar screen. We don't fit the mold of paid organizations that are building satellites. Universities are also struggling with ITAR compliance as there are no public domain satellites when special boards are added, such as experiments. In some cases, universities are excluding foreign nationals from satellite projects as a precaution, even though a significant percentage of their engineering students are foreign nationals.

In summary, the past two years have been stressful ones for AMSAT as we have dealt with ITAR and come to understand the roles and responsibilities under this law. Unfortunately, a cornerstone of AMSAT's relationships with other AMSAT organizations for the past 30 years (international satellite development for the benefit of Amateur Radio worldwide) is no longer encouraged under US law. This inability to cooperate openly on international projects without severe burdens placed on individuals and organizations is a significant loss for Amateur Radio, and in turn for US science and technology.

On a brighter note, AMSAT's legal obligations are now well-understood and our volunteers who were involved in prior international projects no longer worry about legal consequences of past actions. We are in position to look forward rather than be concerned about the past. Just as important, AMSAT has done its best to try to maintain some semblance of international cooperation in the midst of a regulatory environment that discourages such activity. Hopefully, the regulatory environment may evolve, but until legal conditions do indeed change, it looks as if AMSAT will be working on its own satellite projects without the cooperation of foreign nationals for the foreseeable future.

Footnotes

- [1] Ress, Bill, N6GHZ, "ITAR and AMSAT (And other export control rules)", *Proceedings of the AMSAT-NA 26th*

Space Symposium, (Silver Spring, MD: AMSAT, 2008), 4-10.

- [2] Baines, Barry, "ITAR", e-mail to Frank Schuchat, November 7, 2008.
- [3] Schuchat, Frank "Voluntary Disclosure - AMSAT", Letter to DDTC, January 12, 2009
- [4] Schuchat, Frank, "1/15/09 Letter from State Department", e-mail to Barry Baines, January 26, 2009 with attachment
- [5] Baines, Barry, "AMSAT's Plans for ITAR Compliance", e-mail to 19 Recipients, January 27, 2009 with attachment
- [6] Schuchat, Frank, "State Department Filing", e-mail to Barry Baines, March 13, 2009
- [7] Smith, Glen, "DDTC Case No. 09-0000333", letter to Frank Schuchat, March 24, 2009
- [8] Baines, Barry, "State Department Response to AMSAT's Voluntary Disclosure", e-mail to AMSAT BoD and others, April 5, 2009
- [9] Schuchat, Frank, "AMSAT-Compliance Follow-up to Disclosure", e-mail to Anthony Dearth, April 20, 2009 with attachments
- [10] Pitner, Timothy, "AMSAT Commodity Jurisdiction Requests", e-mail to Barry Baines & Frank Schuchat, July 30, 2009 with attachments
- [11] Schuchat, Frank, "CJ Request", e-mail to Barry Baines, October 16, 2009 with attachment
- [12] Schuchat, Frank, "Request for Advisory Opinion - Registrant Code M-2175 - DDTC Cases CJ442-09, 443-09, 444-09 and 445-09", letter to Mr. Walt Rainey, December 4, 2009
- [13] Pitner, Timothy, "State Dept's Advisory Opinion", e-mail to Barry Baines, March 1, 2010
- [14] Schuchat, Frank, "Re: AMSAT", e-mail to Barry Baines, March 19, 2010, "Individuals would have to sign an end-user certificate"
- [15] Ress, Bill, "ITAR and AMSAT (and other export control rules)," page 9. See this page for a brief overview of documentation and reporting rules regarding administration of TAAs. ☺

AMSAT BoD Telecon Meeting, 5 January 2010

Called to order by President Barry Baines, WD4ASW at 2005 EST.

Attending:

Directors:

Barry Baines, WD4ASW
Tom Clark, K3IO
Gould Smith, WA4SXM
Drew Glasbrenner, KO4MA
Lou McFadin, W5DID
Bill Ress, N6GHZ
Alan Biddle, WA4SCA
Tony Monteiro, AA2TX (Alternate)

Others:

Martha Saragovitz, Officer Manager
Keith Baker, KB1SF, Treasurer Elect

Due to the resignation of AMSAT Treasurer Gunther Meisse, W8GSM, President Baines appointed Keith Baker, KB1SF/ VA3KSF, to fill this position on an interim basis, pending formal approval by the BoD. Keith spoke briefly, stating that the transition had gone smoothly, and that he would be continuing with past practices. He did bring up the status of the AMSAT logo registration status. Martha reported that it had recently been renewed. Barry moved, and Tom seconded, that Keith be approved. This was passed unanimously.

The final version of the AMSAT Bulletin Board Acceptable Use Policy (AUP) was brought up for discussion. Bill expressed concern that the dissemination was not adequately addressed, particularly with respect to the Bulletin Board itself. Both Tom and Gould mentioned that the implementation was separate from the AUP, and Lou emphasized that it should be in any case readily accessible. Gould assured the BoD that it would be widely disseminated, including the Bulletin Board itself. With this clarification, it was moved by Barry and seconded by Alan and Tom that the AUP be accepted. This was passed unanimously.

The current working revision of the AMSAT budget was not approved at the annual BoD meeting due to some information not being available. This information is now reflected in version #8, though Lou emphasized that the ARISat-1 budgeting was still incomplete. It was moved by Barry and seconded by Drew that this version be approved. This was passed unanimously.

It was moved by Barry and seconded by Drew that the 3 November 2009 BoD telecon meeting be approved as circulated and published in The AMSAT Journal. This was passed unanimously.

There being no additional formal business, it was moved by Barry and seconded by Alan that the meeting be adjourned. This was passed unanimously.

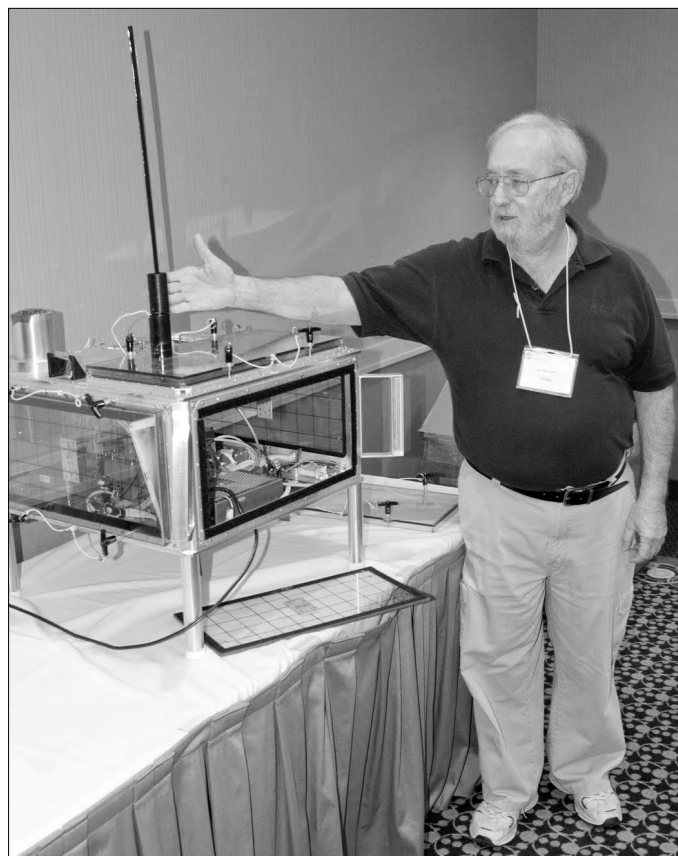
The Official Board meeting closed at 2027 EST.





Art Feller, W4ART

The ARISSat-1 engineering model was on display and operating in all modes during the Symposium. The two flight satellites (primary and backup) had been shipped to NASA.



Art Feller, W4ART

ARISSat-1 Engineer Lou McFadin, W5DID, discusses the antenna installation on the satellite.

2010 Symposium Chairman Kermit Carlson, W9XA, (left) and AMSAT-NA President Barry Baines, WD4ASW, (right).



Art Feller, W4ART



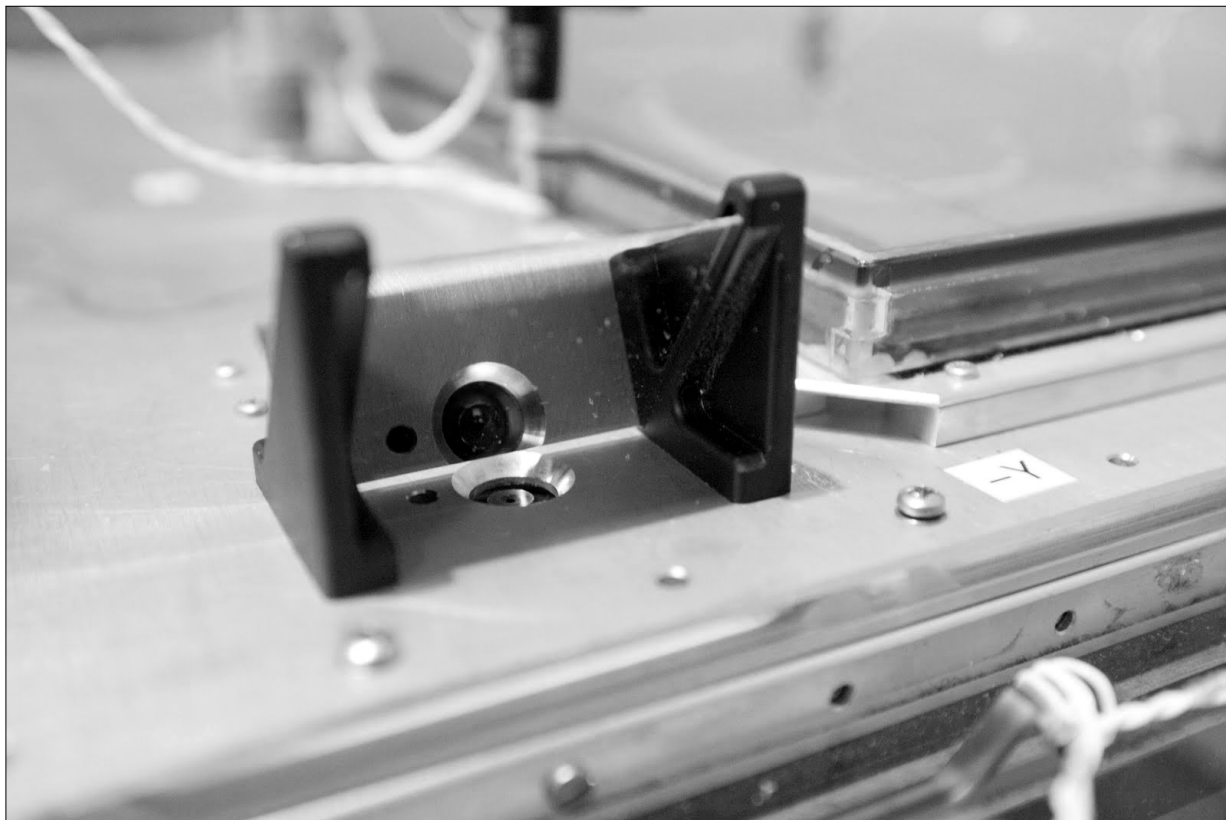
Art Feller, W4ART

AMSAT Vice President Engineering Tony Monteiro, AA2TX.



Art Feller, W4ART

AMSAT Vice President Engineering Tony Monteiro, AA2TX, discussed the Software Defined Radio beacon, telemetry and transponder aboard the ARISSat-1 satellite. The ARISSat-1 flight will be the first test of this SDR technology suitable for deployment on future Amateur Radio satellite missions.



Art Feller, W4ART

Close up view of one of the cameras which will take pictures of the earth and transmit them via the FM SSTV downlink.



Reach for the stars.

N3UC, formerly N4USI, control operator of AO-27, says, "AO-27 may be getting old and failing at times, after 15 years circling the earth. But, my IC-910H that I use to control AO-27, using data transmissions, has never failed me".

Icom 910H The perfect satellite rig.



Have fun communicating with these satellites using the IC-910H:

AO-27, SO-50, AO-51, and VO-52.

In the near future, check out these satellites:

AMSAT-Phase 3E, AMSAT-Eagle, SumbandilaSAT, and KiwiSAT.

Coming to the sky near you! Visit an authorized Icom dealer today!

amateur | avionic | land mobile | marine | receiver | system | www.icomamerica.com

*For further satellite information visit www.amsat.org.

©2009 Icom America Inc. The Icom logo is a registered trademark of Icom Inc. AMSAT is a registered trademark of the Radio Amateur Satellite Corporation. 30122

ICOM®